PB86-172392

Superfund Record of Decision (EPA Region 1)
Charles George Reclamation Trust Landfill
Tyngsborough, Massachusetts
(Second Remedial Action), July 1985

(U.S.) Environmental Protection Agency
Washington, DC

11 Jul 85

U.S. Department of Commerce
National Technical Information Service
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Office of
Emergency and
Remedial Response

EPA/ROD/R01-85/008
July 1985

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EPA

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

The Charles George Land Reclamation Trust Landfill (CGLRT) site is a 69-acre landfill located in Tyngsborough, Massachusetts about 30 miles northwest of Boston and 4 miles south of Nashua, New Hampshire. From 1955 until 1971, the site was operated as a municipal dump. In 1973, CGLRT was issued a permit by the Massachusetts Division of Water Pollution control to handle hazardous wastes in addition to municipal and domestic refuse. Disposal of hazardous wastes and substances, primarily in the form of drummed and bulk chemicals containing volatile organics and toxic metal sludges, continued from January 1973 to at least June 1976. The exact quantity of hazardous substances disposed at the site is unknown. Records submitted by the landfill operators and other available information show that at least 2,500 cubic yards of chemical waste material were landfilled and over one-thousand pounds of mercury were disposed of at the site.

The selected remedial action includes the installation of: a full synthetic membrane cap, a surface water diversion and collection system; a vent network with an off-gas collection system venting to the atmosphere; and a full peripheral leachate collection system. Total capital cost for the selected remedial alternative is estimated to be $13,613,725 and O&M costs are approximately $1,252,901 per year.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Charles George, MA Contaminated media: air, gw, sw, wetlands Key contaminants: volatile organics, sludge, acids, heavy metals (mercury), toluene Dis.		

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RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION

SITE: Charles George Reclamation Trust Landfill
Tyngsborough, Massachusetts

DOCUMENTS REVIEWED

I am basing my decision primarily on the following documents describing the analysis of cost-effectiveness of remedial alternatives for the Charles George Site:

1. Charles George Reclamation Trust Landfill, Tyngsborough, Massachusetts, Remedial Action Master Plan , November 1983, prepared by NUS Corporation, Pittsburgh, Pennsylvania.
2. Charles George Reclamation Trust Landfill, Tyngsborough, Massachusetts, Work Plan for the Remedial Investigation/ Feasibility Study, March 1984, prepared by NUS Corporation, Pittsburgh, Pennsylvania.
3. Charles George Reclamation Trust Landfill, Tyngsborough, Massachusetts, Draft Source-Oriented Feasibility Study, March 1985, prepared by NUS Corporation, Pittsburgh, Pennsylvania and EPA comments on the draft document.
4. Summary of Remedial Alternative Selection (attached)
5. Community Relation Responsiveness Summary (attached)
6. The National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300.
7. 40 C.F.R. Part 264 - Standards for Owners and Operators of Hazardous Waste Treatment, Storage, Disposal Facilities, Subpart F - Groundwater Protection; Subpart G - Closure and Post Closure; Subpart N (264.310 a and b) - Closure and Post

Closure Care.

8. Executive Order 11988 - Floodplain Management
9. Executive Order 11990 - Protection of Wetlands
10. 40 C.F.R. Appendix A Part 6 - Statement of Procedures on Floodplain Management and Wetlands Protection.
11. Preliminary Wetlands Assessment for the Charles George Reclamation Trust Landfill, Tyngsborough, Massachusetts, prepared by U.S. Environmental Protection Agency, Water Division, Wetland Section.

DESCRIPTION OF SELECTED REMEDY

REMEDY

- Full synthetic membrane cap (with the establishment of a 3:1 grade where required.)
- Surface water diversion and collection system
- Vent network with off-gas collection system venting to the atmosphere
- Full peripheral leachate collection system

OPERATION AND MAINTENANCE REQUIREMENTS

- Annual mowing and maintanence of the vegetated surface
- Quarterly inspection of the following:
  - pump station
  - leachate collection/disposal
  - cap surface

DECLARATION

Consistent with the Comprehensive Environmental Reponse Compensation, and Liability Act of 1980 (CERCLA), and the National Contingency Plan (40 CFR Part 300), I have determined that the full synthetic membrane cap , surface water diversion and collection system, vent network with off-gas collection system venting to the atmosphere, and full peripheral leachate collection system at the Charles George Site is a cost-effective remedy and provides adequate protection of public health, welfare, and the environment. The State of Massachusetts has been consulted and agrees with the approved remedy. In addition, the action will require future operation and maintenance activities to ensure the continued effectiveness of the remedy. These activities will be considered part of the approved action and eligible for Trust Fund monies.

I have also determined that the action being taken is appropriate when balanced against the availability of Trust Fund monies for use at other sites.

EPA will undertake an additional feasibility study to evaluate the groundwater and off-site remediation, whether the treatment of vent gases is required, and the effectiveness of the leachate handling option selected. If additional remedial actions are determined to be necessary, a Record of Decision will be prepared for approval of the future remedial action.

7/11/85
Date

Regional Administrator

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION
CHARLES GEORGE LAND RECLAMATION TRUST LANDFILL

INTRODUCTION

The Charles George Land Reclamation Trust (CGLRT) Landfill located primarily in Tyngsborough, Massachusetts is a large and relatively complex site. In order to facilitate clean up, the decisions concerning long-term remedial action at this site have been broken into three Records of Decision (ROD).

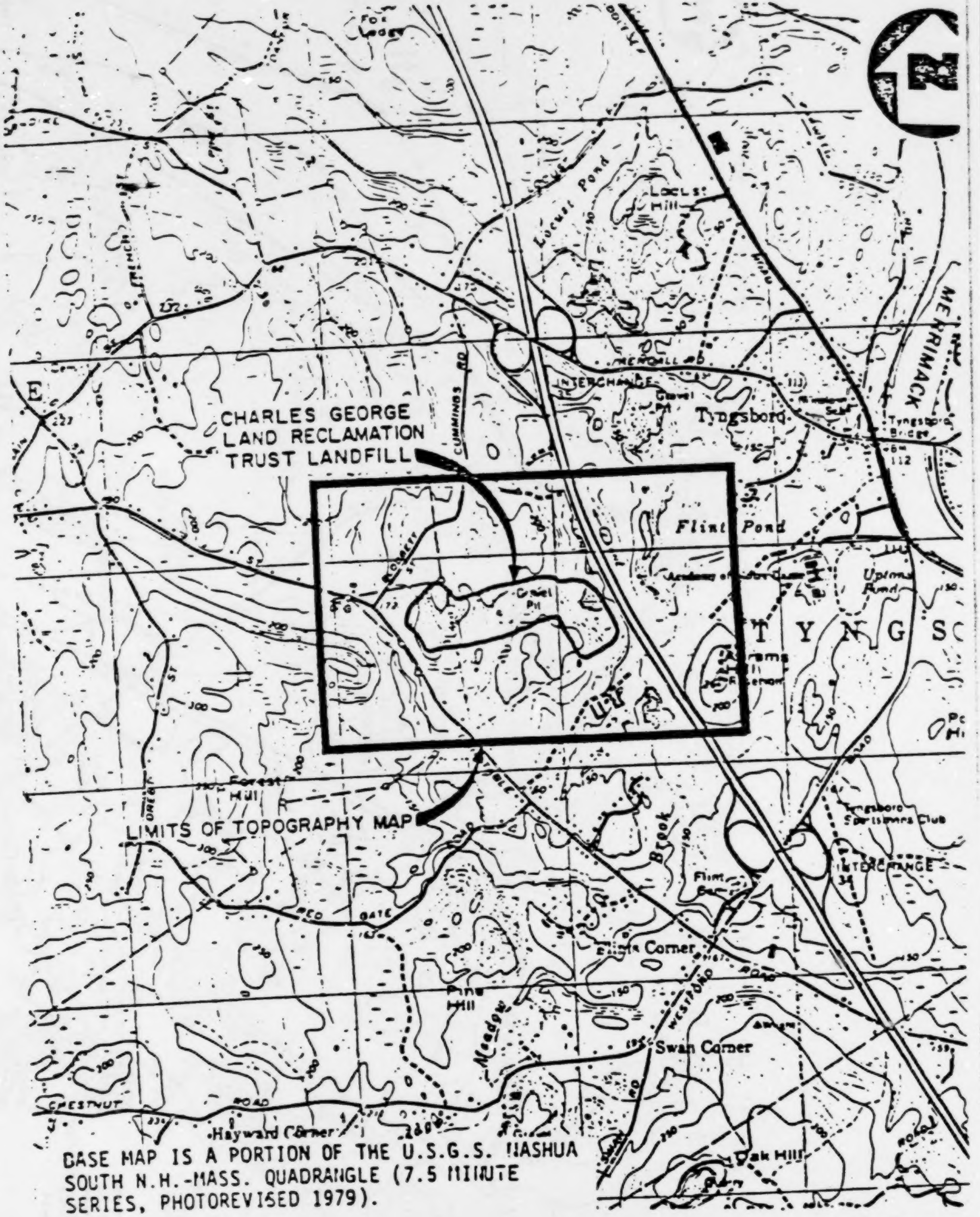
The first ROD signed December, 1983, addressed the planned installation of a permanent water supply line to the residents of the Cannongate/Red Gate road area. The focus of this ROD is the implementation of source control measures to contain contamination and thereby to minimize any further off-site impacts. The third and final ROD will select remedial actions designed to clean-up and control off-site contamination and resolve any remaining on-site issues.

LANDFILL LOCATION AND DESCRIPTION (see figure 1 and 2)

The Charles George Land Reclamation Trust Landfill site is a 69-acre landfill located primarily in Tyngsborough, Massachusetts about 30 miles northwest of Boston and 4 miles south of Nashua, New Hampshire. The site occupies approximately 60-acres in Tyngsborough and 9 acres in the adjoining Town of Dunstable, Massachusetts. Access to the site is via Route 3 to the Tyngsborough Interchange. The site lies immediately adjacent to Route 3, and is reachable via Dunstable Road. The landfill entrance lies at the intersection of Dunstable Road and Blodgett -Cummings Road, at the northwestern corner of the site.

The land adjacent to the landfill is predominantly a rural wooded area with developed land primarily devoted to residential and recreational purposes. The closest residences are located on Dunstable Road, Blodgett St., and Cummings Road within a radius of 500 feet to the north and west of the landfill. The Cannongate Condominium Complex (96 units) and private residential homes are approximately 500 feet south of the site. Another residential community, 1000 feet east of the landfill, exists along the north and east shores of Flint Pond. All the area residents are on private drinking water wells. A day school, the Academy of Notre Dame, is situated along the southwest shore of the Flint Pond.

There are two surface water resources within the immediate site vicinity which are impacted by contamination at the site, Dunstable Brook and Flint Pond. To the west of the site is Dunstable Brook. Sampling data of Dunstable Brook indicates the presence of contaminants from the landfill. The Brook flows in a southerly direction before turning east, then northeasterly, discharging into Flint Pond Marsh, which in turn supplies Flint Pond. Flint Pond is a shallow pond immediately east of the landfill. While [illegible] -1-a


CHARLES GEORGE
LAND RECLAMATION
TRUST LANDFILL
LIMITS OF TOPOGRAPHY MAP
Fox Ledge
Locust Pond
Locust Hill
MERRIMACK
INTERCHANGE
Gravel Pit
Tyngsboro
Tyngsboro Bridge
Flint Pond
Upton Pond
T Y N G S
Abrams Hill
Reservoir
Forest Hill
Brook
Tyngsboro Sportsmens Club
INTERCHANGE
Flint Corner
Pine Hill
Meadow
Swan Corner
WESTFORD ROAD
CHESTNUT ROAD
Hayward Corner
Oak Hill
CUMMINGS RD
N

BASE MAP IS A PORTION OF THE U.S.G.S. NASHUA SOUTH N.H.-MASS. QUADRANGLE (7.5 MINUTE SERIES, PHOTOREVISED 1979).

FIGURE 1-1

LOCATION MAP
CHARLES GEORGE SITE, TYNGSBORO, MA
SCALE: 1"=2000'

NUS CORPORAT
A Halliburton Com

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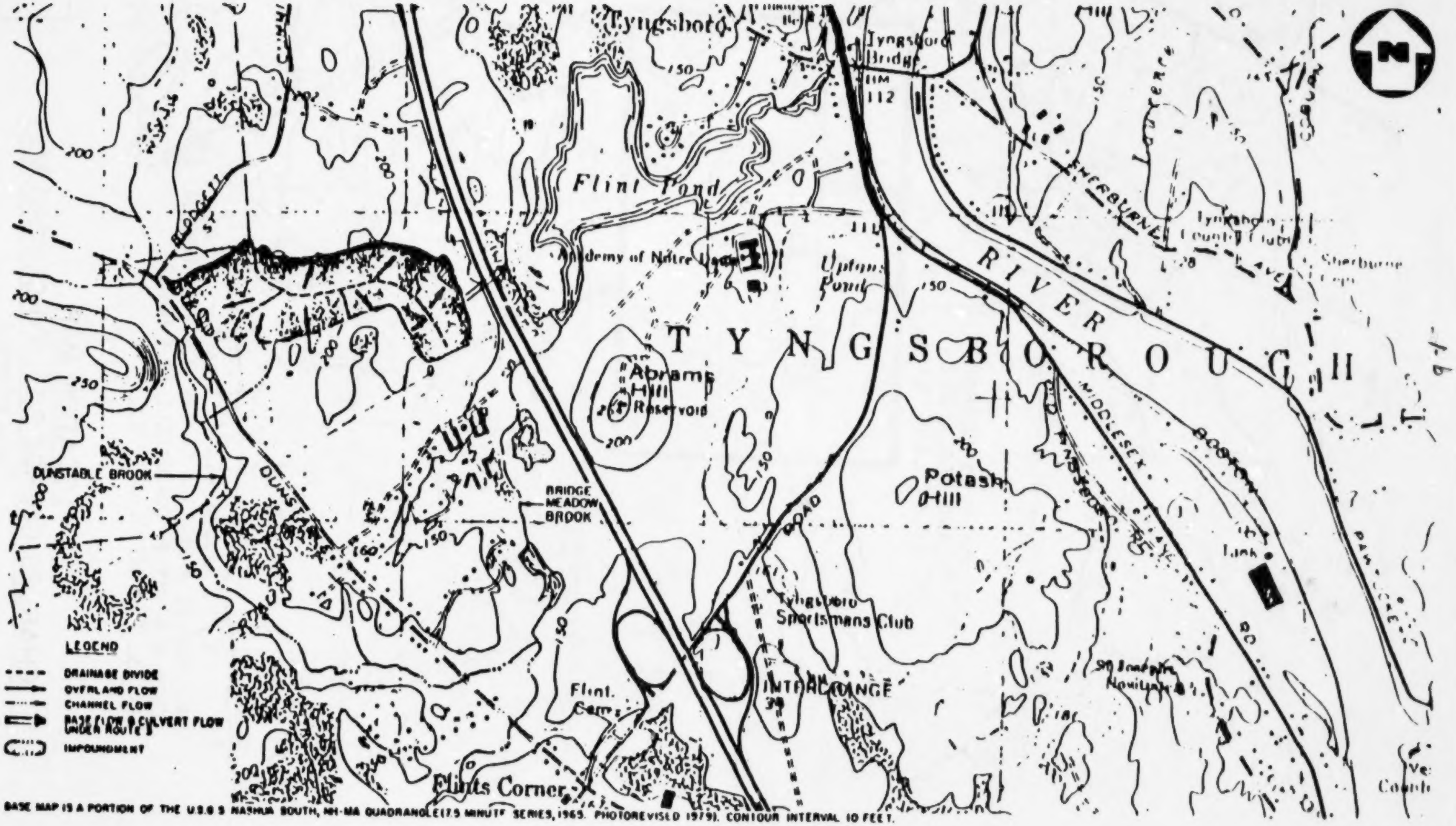
Figure 1


Tyngsboro
Tyngsboro Bridge
BM 112
Flint Pond
Academy of Notre Dame
Uptons Pond
TYNGSBOROUGH
RIVER
Abrams Hill
Reservoir
Potash Hill
Tyngsboro Sportsmans Club
INTERCHANGE 35
Flint Cem
Flints Corner
DUNSTABLE BROOK
BRIDGE MEADOW BROOK
MIDDLESEX
BOSTON
RD
SHERBURNE
LAKEVIEW AVE
Lawrence
Tyngsboro Country Club
Sherburne Corp
Tank
200
250
150
LEGEND
DRAINAGE DIVIDE
OVERLAND FLOW
CHANNEL FLOW
BASE FLOW & CULVERT FLOW UNDER ROUTE 3
IMPOUNDMENT

BASE MAP IS A PORTION OF THE U.S.G.S NASHUA SOUTH, NH-MA QUADRANGLE(7.5 MINUTE SERIES, 1965. PHOTOREVISED 1979). CONTOUR INTERVAL 10 FEET.

1-b

1

FIGURE 1-4

SURFACE WATER DRAINAGE PATTERNS
CHARLES GEORGE SITE, TYNGSBORO, MA
SCALE 1" = 1000'

1000 0 1000
SCALE IN FEET

NUS CORPORATION
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Figure 2

Ar

Route 3 physically separates the Pond from the site, a drainage culvert under the highway provides a direct conduit for site leachate to impact the Pond. Drainage from this culvert, which contains leachate contaminated by hazardous substances, enters Flint Pond Marsh. Sample results indicate contamination of the marsh which is the headwater for Flint Pond proper. The outlet of the Pond discharges into the Merrimack River, futher to the east of the site. The Merrimack River is the drinking water source for the downstream communities of Lowell, Lawrence, and Methuen. There are six wetlands in the vicinity of the site. These six areas are discussed preliminarily in the Wetlands Assessment (Attachment 1). A review of the Federal Emergency Management Agency map dated September 2, 1982, for this area indicates that the site is not in a Floodplain and the proposed Remedial Action will not impacy a floodplain. Groundwater flow from the landfill occurs in two unconfined aquifers as documented in the various engineering studies referenced. The first is a shallow aquifer beneath the site. It consists of unconsolidated deposits of glacial till and stratified sand deposits. The other aquifer is to the southwest of the site located in the bedrock and consists of highly fractured metamorphic and less fractured igneous rock. There is a hydraulic connection between these aquifers; and therefore they may be considered as one hydrologic unit. The topograpy in the eastern half of the site is believed to have consisted of a central lowland filled with outwash sands and gravels prior to the creation of the landfill. This lowland was flanked on the north and south by higher knobby terrain. The western half of the site was characterized by three small drumlins.

The site area has a shallow depth to bedrock, though widely varying (from 5 feet to over 80 feet below grade), and a high groundwater table. The base of the landfill appears to lie between 180 and 190 feet above mean sea level (msl). The groundwater table is approximately 1 foot to 15 feet below the surface depending upon seasons of the year. A partial leachate collection system is in place at the site which is intended to drain to sumps at the eastern and western landfill peripheries. Discharge from the eastern sump is pumped back to the eastern landfill crest. Leachate collected in the western sump is currently pumped to a sedimentation basin on the western landfill periphery. This system continually breaks down and is frequently inoperative allowing leachate to migrate off site into local drainage systems.

In the northwestern corner of the landfill there remain a number of above ground structures relating to the landfilling operations. These items consist of approximately 30 large industrial dumpsters, a 40 ft. by 110 ft. maintenance garage, and miscellaneous scrap metal, machinery, and truck parts.

Site History

Previous reports indicate that waste disposal activity at this site was initiated near the intersection of Dunstable and Blodgett-Cummings Road in 1955. During the period from 1955 until the land was purchased by Charles George Sr. in 1967, the site was operated by persons unknown under contract to the Town of Tyngsborough as a municipal dump. This site continued as a municipal dump following acquisition by Charles George Sr. in 1967 and by Charles George Sr. and Dorothy George as Trustees of CGLRT in July 1971. In 1973, CGLRT was issued a permit by the Massachusetts Division of Water Pollution Control (DWPC) to handle hazardous wastes in addition to municipal and domestic refuse. Disposal of hazardous wastes and substances primarily in the form of drummed and bulk chemicals containing volatile organics and toxic metal sludges continued from January 1973 to at least June 1976. The exact quantity of hazardous substances disposed of at the site is unknown. Records submitted by the landfill operators and other available information show that at least 2,500 cubic yards of chemical waste material were landfilled at the site. Records submitted to EPA also show that over a thousand pounds of mercury were disposed of at the site.

In 1982, the Tyngsborough Board of Health suspended the assignment of the CGLRT land as a landfill. At approximately the same time, formal notice was served by the Massachusetts Department of Environmental Quality Engineering (DEQE) that two wells serving the Cannongate Condominiums were no longer considered suitable as a potable water supply and were ordered closed. This action was taken in light of increasing levels of volatile organic contamination in the wells. In order to provide a temporary solution to the water shortage created by loss of the wells, an above ground water line was installed by the DEQE from the North Chelmsford Water District to the condominiums. The water line froze and was subsequently dismantled in December 1982. A Removal Action, pursuant to the National Contingency Plan (NCP) at 40 CFR §300.65 (a) (2), an insulated pipeline was installed by the EPA's Environmental Response Team (ERT) in 1983. This line continues to serve the residents of the Cannongate Condominiums.

The EPA completed a Focused Feasibility Study in September of 1983 evaluating the need and most practical route for a permanent waterline to replace the temporary aboveground line. The EPA signed a ROD on the permanent waterline issue in December of 1983. The permanent waterline will connect the Cannongate/Red Gate road area with the City of Lowell's existing municipal water system. When installed, the line will consist of approximately 4.9 miles of pipe, a 514,000 gallon storage tank, and a pump station. The construction of the waterline will not only replace the temporary Cannongate system but will also be able to serve residents whose drinking water may become contaminated by the release of hazardous substances from the site into the groundwater. There is an ongoing monitoring program of those residences still on private wells and not served by the temporary water line. Construction on the line is scheduled to start in the fall of 1985.

During the fall of 1983 and winter of 1984, the ERT also installed a security fence on portions of the landfill, regraded portions of the landfill, placed a soil cover over exposed refuse, and installed 12 gas vents along the crest of the landfill. These vents are intended to provide temporary control of gas emissions until a more permanent remedy can be implemented.

Current Site Status

A number of actions have been undertaken by the EPA since its initial involvement. These actions not only included Removal actions, such as the temporary waterline, but also preliminary site investigations including some limited hydrogeologic surveys.

The current ongoing investigation is the Remedial Investigation (RI). This RI started in summer of 1984 and is expected to be completed in the fall of 1985. The RI will primarily address the extent of off-site contamination and will evaluate off-site remedial actions.

The Charles George landfill, as noted earlier, is a large (69 acres) site with approximately 4 million cubic yards of refuse contained on-site. Within this refuse an estimated 2,500 cubic yards of hazardous substances have been disposed of. Landfilling operations ceased in June, 1983, leaving the site with inadequate cover material to prevent precipitation from infiltrating the landfill with subsequent leachate generation. The landfill has developed large erosion gullies, exposing refuse, on all sides of the site. In addition, there are numerous areas where leachate breaks out to the surface of the landfill. These breakouts mix with the surface runoff and quickly flow offsite. This fact is evidenced by the substantial amount of distressed vegetation surrounding the landfill. The results from the RI field studies indicate that volatile organics, acids, and heavy metals are the most commonly occurring contaminants found both on and off site. Some of the data is summarized in Tables 1, 2a, 2b, and tables 3 through 6. Included in each table is the exsisting federal standards and criteria for each compound listed.

Table 1 summarizes leachate data migrating from the landfill to surface receptors including soils, vegetation, and water courses. As can be seen, the leachate contains known human carcinogens, various volatile organic compounds, and heavy metals which are significantly in excess of available criteria. Potential receptors include surrounding flora and fauna as well as humans transversing

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TABLE 1. SUMMARY OF LEACHATE CONTAMINANTS
CHARLES GEORGE SITE
TYNGSBOROUGH, MASSACHUSETTS
JULY 11, 1986
ALL VALUES IN PARTS PER BILLION (PPB)

CONTAMINANT	CRITERIA	CONCENTRATION RANGE LOW	CONCENTRATION RANGE HIGH	SINGLE OBSERV.	DETECTION FREQENCY	NUMBER EXCEEDING CRITERIA	RELIABILITY (VALIDATION)	COMMENTS
VOLATILE ORGANICS								
VINYL CHLORIDE	2.00A	DL	250		4/8	4	J	MINOR CONSTITUENT
METHYLENE CHLORIDE	NONE	710	7200		3/8	-	J	MUCH OF THE DATA WAS REJECTED DUE TO SAMPLE CONTAMINATION AND LAB QC
ACETONE	NONE	11000	18000		3/8	-	J	MUCH OF THE DATA WAS REJECTED DUE TO SAMPLE CONTAMINATION AND LAB QC
1,1-DICHLOROETHANE	4050B	DL	83		6/8	0	J	MAJOR CONSTITUENT
TRANS 1,2-DICHLOROETHENE	NONE	170	290		8/8	-	A	MAJOR CONSTITUENT
2-BUTANONE (MEK)	700A*	DL	21000		7/8	7	A	MAJOR CONSTITUENT
4-METHYL, 2-PENTANONE (MIBK)	NONE	DL	1800		6/8	-	J	MAJOR CONSTITUENT
TOLUENE	340C	580	700		8/8	8	A	MAJOR CONSTITUENT
ETHYL BENZENE	1400D	DL	140		8/8	0	J	MAJOR CONSTITUENT
TOTAL XYLENES	620C	DL	180		6/8	0	A	MAJOR CONSTITUENT
A/B/N/ ORGANICS								
PHENOL	3500AD	DL	3000		5/8	0	J	MINOR CONSTITUENT
4-METHYLPHENOL	NONE	4600	12000		8/8	-	J	MAJOR CONSTITUENT
BENZOIC ACID	NONE			38000	1/8	-	J	MINOR CONSTITUENT
INORGANICS								
ALUMINUM	NONE	1700	47200		3/3	-	J	MAJOR CONSTITUENT
ARSENIC	0.0022AD	20	30		3/3	3	A	MAJOR CONSTITUENT
BARIUM	1000E	630	640		3/3	0	A	MAJOR CONSTITUENT
CHROMIUM	50DE	95	190		3/3	3	A	MAJOR CONSTITUENT
IRON	300F	380000	660000		3/3	3	A	PRIMARY CONSTITUENT
LEAD	1D	17	43		3/3	0	A	MINOR CONSTITUENT
MANGANESE	50F	10000	24000		3/3	3	A	MINOR CONSTITUENT
MERCURY	0.144D	DL	.50		1/3	1	J	
ZINC	58D	770	2900		3/3	3	J	
CADMIUM	0.00449A	1	10		3/3	3	J	MINOR CONSTITUENT
NICKEL	0.0304A	18	260		3/3	3	J	MINOR CONSTITUENT
TIN	NONE	21	62		3/3	-	A	MINOR CONSTITUENT

NOTES:

DL = DETECTION LIMIT

VALIDATION CODES:
A = ACCEPTED
J = APPROXIMATED

CRITERIA SOURCES (MOST CONSERVATIVE VALUES HAVE BEEN REPORTED; IN SOME CASES THE MOST CONSERVATIVE VALUES HAVE BEEN DEVELOPED IN CONJUNCTION WITH OCCUPATIONAL RISK ASSESSMENT BASED UPON CONTINUAL, FREQUENT EXPOSURE, AND MAY NOT BE STRICTLY APPLICABLE TO ASSESSMENT OF THREAT OF ENVIRONMENTAL EXPOSURE

A = PRELIMINARY PROTECTIVE CONCENTRATION LIMIT (PPCL) BASED ON 0.000001 UNIT CANCER RISK LEVEL
A* = AS ABOVE, BASED ON INHALATION STUDY
B = PPCL BASED ON ACCEPTEABLE DAILY INTAKE CRITERIA
C = SAFE DRINKING WATER ACT (DWA) HEALTH ADVISORY - CHRONIC EXPOSURE LIMIT
D = CLEAN WATER ACT (CWA) WATER QUALITY CRITERIA (DRAFT STANDARD FOR MERCURY; VALUE GIVEN FOR CHROMIUM IS FOR HEXAVALENT SPECIES
E = SAFE DRINKING WATER ACT MAXIMUM CONTAMINANT LEVEL (MCL)
F = USEPA SECONDARY DRINKING WATER STANDARDS

the area or using the water bodies as recreational or drinking sources.

Tables 2A and 5 reflect organic and inorganic compounds flowing in groundwater which contains moderate to very high concentrations. Most groundwater flows through fractured bedrock as shown by the installation of many monitoring wells during the ongoing Phase III Remedial Investigation. Potential receptors include the Cannongate Condominium wells which have been closed due to contamination and any other persons using the aquifer for drinking water. Tables 2, 3, and 4 indicate organic and inorganic contaminants found in wetlands and surface waters surrounding the site. Again potential receptors include flora and fauna as well as humans coming into contact with surface waters.

The primary focus of the Source Control Feasibility Study is to control leachate from CGLRT, which contains the highest concentrations of contaminants. The Phase III RI/FS (offsite) will address the remedial alternatives for offsite surface and groundwater contamination.

It is estimated, based on a water balance model in the Source Oriented Feasibility Study, that the site presently generates approximately 36 million gallons of leachate per year. Using the average concentrations of compounds detected in the leachate it is estimated that over 9,300 pounds of Total Volatile Organic Compounds and over 188,000 pounds of toxic heavy metals are migrating offsite per year.

There are four potential routes of exposure associated with the CGLRT Landfill: direct contact, surface water, groundwater, and air.

The surface waters and wetlands surrounding the site are a major environmental concern. They flow through residential neighborhoods, are used for recreational purposes, and provide a habitat for wildlife (ducks, fish, etc.). Wildlife that feed and nest on, or near, the landfill may be exposed and accumulate contaminants from the site.

The leachate is impacting the surrounding surface waters and wetlands as shown by similar contaminants found in the surface waters and wetlands as those which were found in the leachate. There are several major routes for surface migration of the leachate off-site which have been identified. These are on the east, west, and southern sections of the landfill. First, on the western section of the landfill, leachate flows under Dunstable Road and into Dunstable Brook. During periods of precipitation the leachate is so voluminous that it flows across Dunstable Road, often times so deep that cars have to slow down almost to a stop in order to be able to safely drive through it. The Brook

TABLE 2a

ORGANIC COMPOUNDS FOUND IN GROUNDWATER
CHARLES GEORGE SITE
TYNGSBOROUGH, MASSACHUSETTS

Compound*	Relative Concentration
Methylene Chloride	Very High
Acetone	Very High
Benzene	High
Toluene	High
4-Methylphenol	Moderate
1,1-Dichloroethane	Low
Trans-1,2-dichloroethane	Moderate
2-Hexanone	High
Ethylbenzene	Moderate
Total Xylenes	Low - Moderate
Phenol	Moderate
2-Butanone (MEK)	Very High
4-Methyl-2-pentanone (MIBK)	High
Bis(2-ethylhexyl)phthalate	Low - Moderate
Benzoic Acid	High - Very High
2-Methylphenol	Low - Moderate
Phenanthrene	Low
Diethyiphthalate	Low

Ranges: ≥ 10,000 ppb = Very high
1,000-10,000 ppb = High
100-1,000 ppb = Moderate
DL-100 ppb = Low
(DL = Detection Limit)

Source: NUS Corporation, Pittsburgh, Pennsylvania (March 1985)

*Listed in order of decreasing frequence of occurrence

TABLE 2a

TABLE 2b SUMMARY OF FLINT POND/WETLAND CONTAMINANTS
CHARLES GEORGE SITE
TYNGSBOROUGH, MASSACHUSETTS
JULY 11, 1986
ALL VALUES IN PARTS PER BILLION (PPB)

CONTAMINANT	CRITERIA	CONCENTRATION RANGE LOW	CONCENTRATION RANGE HIGH	SINGLE OBSERV.	DETECTION FREQENCY	NUMBER EXCEEDING CRITERIA	RELIABILITY (VALIDATION)	COMMENTS
VOLATILE ORGANICS								
ACETONE	NONE	DL	12000		6/10	-	J	DETECTED IN SOME BLANKS IN NOTABLE QUANTITIES
BENZENE	0.673A	0	+96		3/10	1	A	CONFIRMED BELOW DETECTION LIMIT
TOLUENE	340C	DL	200		6/10	0	J	
2-HEXANONE	NONE			6	1/10	-	Z	
4-METHYL, 2-PENTANONE (MIBK)	NONE			130	1/10	-	Z	
ETHYLBENZENE	14000			17	1/10	0	Z	
O-XYLENE	620C			6	1/10	0	Z	
1,1-DICHLOROETHENE	NONE			12	1/10	-	Z	
TETRAHYDROFURAN	NONE			270	1/10	-	Z	MUCH OF THE DATA WAS REJECTED
INORGANICS								
ALUMINUM	NONE			200	1/9	-	A	MUCH OF THE DATA WAS REJECTED
IRON	300F	560	5300		9/9	9	J	
MANGANESE	50F	130	1200		9/9	9	J	
NICKEL	0.0304A			0.21	1/9	1	J	
ZINC	500	16	20		3/9	0	J	MUCH OF THE DATA WAS REJECTED
TIN	NONE			260	1/9	-	J	

NOTES:
DL = DETECTION LIMIT
VALIDATION CODES:
A = ACCEPTED
J = APPROXIMATED
Z = BASED UPON PORTABLE GAS CHROMATOGRAPH FIELD SCREENING BY FIT I
+ = PORTABLE GAS CHROMATOGRAPH FIELD SCREEN BY FIT I
CRITERIA SOURCES (MOST CONSERVATIVE VALUES HAVE BEEN REPORTED; IN SOME CASES THE MOST CONSERVATIVE VALUES HA
BEEN DEVELOPED IN CONJUNCTION WITH OCCUPATIONAL RISK ASSESSMENT BASED UPON CONTINUAL, FREQUENT EXPOSURE,
AND MAY NOT BE STRICTLY APPLICABLE TO ASSESSMENT OF THREAT OF ENVIRONMENTAL EXPOSURE)
A = PRELIMINARY PROTECTIVE CONCENTRATION LIMIT (PPCL) BASED ON 0.000001 UNIT CANCER RISK LEVEL
A* = AS ABOVE, BASED ON INHALATION STUDY
B = PPCL BASED ON ACCEPTABLE DAILY INTAKE CRITERIA
C = SAFE DRINKING WATER ACT (DWA) HEALTH ADVISORY - CHRONIC EXPOSURE LIMIT
D = CLEAN WATER ACT (CWA) WATER QUALITY CRITERIA
E = SAFE DRINKING WATER ACT MAXIMUM CONTAMINANT LEVEL (MCL)
F = USEPA SECONDARY DRINKING WATER STANDARDS

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TABLE 3. SUMMARY OF ROUTE 3 CULVERT CONTAMINANTS
CHARLES GEORGE SITE
TYNGSBOROUGH, MASSACHUSETTS
JULY 11, 1986
ALL VALUES IN PARTS PER BILLION (PPB)

CONTAMINANT	CRITERIA	CONCENTRATION RANGE LOW	CONCENTRATION RANGE HIGH	SINGLE OBSERV.	DETECTION FREQENCY	NUMBER EXCEEDING CRITERIA	RELIABILITY (VALIDATION)	COMMENTS
VOLATILE ORGANICS								
ACETONE	NONE	+1200	*4400		2/4	-	Z	
1,1-DICHLOROETHANE	4050B	+23	*37		2/4	0	Z	
2-BUTANONE (MEK)	700A*	+1900	*3100		2/4	2	Z	
TRICHLOROETHENE	27D	+5	*8		2/4	0	Z	NOT FOUND IN LEACHATE SAMPLES
BENZENE	0.673A	+240	*470		2/4	2	Z	NOT FOUND IN LEACHATE SAMPLES
2-HEXANONE	NONE	*36	+230		2/4	-	Z	NOT FOUND IN LEACHATE SAMPLES
4-METHYL, 2-PENTANONE	NONE	+10	*800		2/4	-	Z	
TOLUENE	340C	+310	*920		2/4	1	Z	
ETHYLBENZENE	1400D	+37	*90		2/4	0	Z	
XYLENES	620C	*20	+30		2/4	0	Z	
BENZOIC ACID	NONE	200	280		2/3	-	A	
DIETHYLPHTHALATE	3500000			6.0	1/3	0	A	NOT FOUND IN LEACHATE SAMPLES; FOUND IN SOME UPSTREAM SAMPLES
2-METHYLPHENOL	NONE			10	1/3	-	J	NOT FOUND IN LEACHATE SAMPLES
BIS(2-ETHYLHEXYL) PHTHALATE	18000D			47	1/3	0	A	NOT FOUND IN LEACHATE SAMPLES; FOUND IN SOME UPSTREAM SAMPLES
DI-n-OCTYL PHTHALATE	NONE			37	1/3	-	J	NOT FOUND IN LEACHATE SAMPLES; FOUND IN SOME UPSTREAM SAMPLES
INORGANICS								
ALUMINUM	NONE			980	1/2	-	J	
ARSENIC	0.0022AD	120	282		2/2	2	A	
BARIUM	70C	140	238		2/2	2	A	
CHROMIUM	50DE			11	1/2	0	A	
COBALT	NONE			13	1/2	-	A	
IRON	300F	45000	78800		2/2	2	A	
LEAD	50DE			2.7	1/2	0	J	
MANGANESE	50E	7600	11400		2/2	2	A	
MERCURY	0.144D			0.27	1/2	1	J	
NICKEL	0.0304A			37	1/2	1	J	
ZINC	50D	12	17		2/2	0	J	

NOTES:

DL - DETECTION LIMIT

VALIDATION CODES:
- A - ACCEPTED
- J - APPROXIMATED
- + - CLP DATA REJECTED INITIALLY; CURRENTLY UNDER REVIEW
- Z - DATA REJECTED IN VALIDATION PROCESS, BUT CORROBORATED VIA FIELD GC
- * - ANALYSIS VIA PORTABLE FIELD GAS CHROMATOGRAPH

CRITERIA SOURCES
- A - PRELIMINARY PROTECTIVE CONCENTRATION LIMIT (PPCL) BASED ON 0.000001 UNIT CANCER RISK LEVEL
- A*- AS ABOVE, BASED ON INHALATION STUDY
- B - PPCL BASED ON ACCEPTEABLE DAILY INTAKE CRITERIA
- C - SAFE DRINKING WATER ACT (DWA) HEALTH ADVISORY - CHRONIC EXPOSURE LIMIT
- D - CLEAN WATER ACT (CWA) WATER QUALITY CRITERIA (DRAFT STANDARD FOR MERCURY; VALUE GIVEN FOR CHROMIUM IS FOR HEXAVALENT SPECIES
- E - SAFE DRINKING WATER ACT MAXIMUM CONTAMINANT LEVEL (MCL)
- F - USEPA SECONDARY DRINKING WATER STANDARDS

TABLE 4. SUMMARY OF DUNSTABLE BROOK CONTAMINANTS (AT LANDFILL DISCHARGE)
CHARLES GEORGE SITE
TYNGSBOROUGH, MASSACHUSETTS
JULY 11, 1985
ALL VALUES IN PARTS PER BILLION (PPB)

		CONCENTRATION RANGE				NUMBER		
CONTAMINANT	CRITERIA	LOW	HIGH	SINGLE OBSERV.	DETECTION FREQENCY	EXCEEDING CRITERIA	RELIABILITY (VALIDATION	COMMENTS
VOLATILE ORGANICS								
ETHYLBENZENE	1400D			24	1/7	0	A	FOUND ONLY IN SUMP CHANNEL
TOLUENE	340C			12	1/7	0	A	FOUND ONLY IN SUMP CHANNEL
TOTAL XYLENES	620C			34	1/7	0	A	FOUND ONLY IN SUMP CHANNEL
A/B/N/ ORGANICS								
BENZOIC ACID	NONE			795	1/8	-	A	FOUND ONLY IN SUMP CHANNEL
DI-n-OCTYL PHTHALATE	NONE	10.4	91.2		2/8	-	J	LOW VALUE ESTIMATED
INORGANICS								
ALUMINUM	NONE	82	790		3/7	-	A	FOUND AT ALL STATIONS
ANTIMONY	1458D	5	57		2/7	0	J	NOT FOUND IN DUPLICATE
BARIUM	1000E	26	710		2/7	1	A	
BERYLLIUM	0.037B			1.0	1/7	1	A	FOUND ONLY IN SUMP CHANNEL
CHROMIUM	42D			7	1/7	0	A	FOUND ONLY AT STATION 002
IRON	300F	920	69000		4/7	4	J	ESTIMATED VALUE
MANGANESE	50F	140	6700		6/7	0	A	
ZINC	580	13	440		3/7	0	J	ESTIMATED VALUE
COBALT	NONE			14	1/7	-	A	
MERCURY	0.144D			5.8	1/7	0	A	

NOTES:
DL = DETECTION LIMIT
VALIDATION CODES:
A = ACCEPTED
J = APPROXIMATED
CRITERIA SOURCES
A = PRELIMINARY PROTECTIVE CONCENTRATION LIMIT (PPCL) BASED ON 0.000001 UNIT CANCER RISK LEVEL
A*= AS ABOVE, BASED ON INHALATION STUDY
B = PPCL BASED ON ACCEPTEABLE DAILY INTAKE CRITERIA
C = SAFE DRINKING WATER ACT (DWA) HEALTH ADVISORY - CHRONIC EXPOSURE LIMIT
D = CLEAN WATER ACT (CWA) WATER QUALITY CRITERIA (DRAFT STANDARD FOR MERCURY; VALUE GIVEN FOR CHROMIUM IS FOR HEXAVALENT SPECIES)
E = SAFE DRINKING WATER ACT MAXIMUM CONTAMINANT LEVEL (MCL)
F = USEPA SECONDARY DRINKING WATER STANDARDS

P-5

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TABLE 5. SUMMARY OF BEDROCK WELL CONTAMINANTS
CHARLES GEORGE SITE
TYNGSBOROUGH, MASSACHUSETTS
JULY 11, 1988
ALL VALUES IN PARTS PER BILLION (PPB)

CONTAMINANT	CRITERIA	CONCENTRATION RANGE LOW	CONCENTRATION RANGE HIGH	SINGLE OBSERV.	DETECTION FREQENCY	NUMBER EXCEEDING CRITERIA	RELIABILITY (VALIDATION)	PREVIOUS CANNONGATE WELL ANALYSES	COMMENTS
VOLATILE ORGANICS									
ACETONE	NONE	*5000	12000		2/2	-	1	370	MAJOR CONTAMINANT
2-BUTANONE (MEK)	0.02A*	*1500	20000		2/2	6	1	1100	MAJOR CONTAMINANT
TRICHLOROETHENE	27D							12	NOT FOUND IN MONITORING WELLS
BENZENE	0.673A	*8	360		2/2	4	1	16	MINOR CONTAMINANT
1,2-TRANS DICHLOROETHYLENE	270B							8	NOT FOUND IN MONITORING WELLS
4-METHYL, 2-PENTANONE	NONE	*6	1600		2/2	-	1	84	MAJOR CONTAMINANT
TOLUENE	340C	*340	840		2/2	4	1	20	MAJOR CONTAMINANT
ETHYLBENZENE	1400D	*14	340		2/2	0	1	17	MINOR CONTAMINANT
TETRAHYDROFURAN	NONE							TRACE	TRACE CONTAMINANT
TOTAL XYLENES	620C							15	NOT FOUND IN MONITORING WELLS
A/B/N ORGANICS									
DIETHYL PHTHALATE	350000D	DL	12		1/2	-	A		MINOR CONTAMINANT
4-METHYLPHENOL	NONE	DL	64		1/2	-	J		MINOR CONTAMINANT
BENZOIC ACID	NONE	DL	300		1/2	-	J		MINOR CONTAMINANT
INORGANICS									
ARSENIC	0.022AD	8.4	58		2/2	2	J		
BARIUM	70C	257	324		2/2	6	A		MAJOR CONTAMINANT
COBALT	NONE	15	29		2/2	-	A		MINOR CONTAMINANT
IRON	300F			73000	2/2	5	A		ONE DATA POINT REJECTED
MANGANESE	50F	11600	28600		2/2	6	A		MAJOR CONTAMINANT
TIN	NONE	30	89		2/2	-	A		MINOR CONTAMINANT
MERCURY	0.144D							0.2	MINOR CONTAMINANT

NOTES:

DL - DETECTION LIMIT

VALIDATION CODES:

A - ACCEPTED
J - APPROXIMATED
1 - ASTERISKED VALUES (*) REJECTION CURRENTLY UNDER REVIEW

CRITERIA SOURCES

A - PRELIMINARY PROTECTIVE CONCENTRATION LIMIT (PPCL) BASED ON 0.000001 UNIT CANCER RISK LEVEL
A*- AS ABOVE, BASED ON INHALATION STUDY
B - PPCL BASED ON ACCEPTABLE DAILY INTAKE CRITERIA
C - SAFE DRINKING WATER ACT (DWA) HEALTH ADVISORY - CHRONIC EXPOSURE LIMIT
D - CLEAN WATER ACT (CWA) WATER QUALITY CRITERIA (DRAFT STANDARD FOR MERCURY)
E - SAFE DRINKING WATER ACT MAXIMUM CONTAMINANT LEVEL (MCL)
F - USEPA SECONDARY DRINKING WATER STANDARDS
G - SAFE DRINKING WATER ACT HEALTH ADVISORY (10-DAY LIMIT)

flows southeasterly into Bridge Meadow Brook, which eventually empties into Flint Pond Marsh. The outlet of the marsh is the primary source of supply to Flint Pond.

Second, on the eastern end of the landfill, the leachate and eroded contaminated soils discharge directly into Flint Pond Marsh through a culvert under Route 3. Flint Pond is used for recreational purposes; Fishing, boating, and swimming have been some of the activities that have been observed. There are 16 residencies along the northern shore that use shallow wells next to the pond as their drinking water supply. These wells are being investigated as part of the Phase III RI/FS. The outlet of Flint Pond flows to the Merrimack River. The Merrimack River is a drinking water source for the downstream communities of Lowell, Lawrence, and Methuen. Samples collected from the Route 3 culvert area contained most of the compounds found in the leachate samples collected during the Phase III RI.

Except for a small area of Flint Pond Marsh, the results of the Preliminary Wetlands Assessment, appended to the ROD, did not document any visually observeable any adverse impacts to the wetlands. During a site tour a fringed area of the marsh running linearly along Route 3 appeared to be dying ("Browned-out from landfill and/or road salt impacts"). However, the assessment recommended that a more thorough and detailed wetlands assessment should be included in the RI/FS. This more thorough investigation will include a characterization of vegetation, hydrology, soils, tissue analysis and wildlife in the wetlands. A Wetland mitigation plan will also be developed as a result of this more detailed assessment the plan will be incorporated into offsite remedial alternatives to be proposed in the Phase III RI/FS of the project. Additionally, a wetlands mitigation plan for the source control will be developed during the design for the source control action.

A final leachate contamination pathway is located along the southern portion of the site. As noted earlier, the landfill is located over a shallow aquifer of unconsolidated deposits and a fractured bedrock aquifer to the southwest. Highly fractured bedrock outcrops along the northern toe of the landfill and along the southeastern drainage channel indicate that areas of exposed bedrock were dynamited in order to expand the landfill. Surface water flow patterns and the close proximity of the landfill to these outcrops provide a direct conduit for the leachate to migrate into the bedrock aquifer. Sampling results of Two bedrock water supply wells (Cannongate wells) 500 feet downgradient of the landfill indicate a significant degree of contamination. Analytical results of downgradient monitoring wells indicate that the landfill has significantly contaminated the shallow and bedrock aquifers. A number of the hazardous substances detected in the aquifers are the same as those found in the landfill leachate. Tables 1, 2a, and 2b summarize this data. A number of the compounds detected during sampling conducted to date on and off site (See Tables 1-6) are either known human carcinogens (e.g. vinyl chloride, benzene), suspected carcinogens (e.g. toluene, arsenic), or cause some adverse health effects such as neurological dysfunction (lead). Many of these compounds exceed federal standards and criteria, such as the Health Advisories and Maximum Contaminant Levels (MCLs) issued pursuant to the Safe Drinking Water Act (SDWA) and water quality criteria and the exposure levels based upon unit cancer risks issued pursuant to the Clean Water Act (CWA). The UCRs are values identified by EPA for drinking water. These levels, UCRs, are based upon an incremental increase in cancer risk of 10^{-6} assuming exposure to a 70 Kg adult consuming 2 liters of water per day. Concentrations of Benzene, 2-Butanone (MEK), and Arsenic are 529, 28, and 2600 times higher than their URC levels, respectively (based upon maximum concentrations in Table 5). Toluene was three times the recommended Health Advisory for Chronic Exposure Limit under the SDWA, while Mercury levels found in the Route 3 culvert were found to be twice the recommended Water Quality Criteria for Mercury.

Several volatile organic compounds were detected in the air samples collected from the vents on the landfill, as part of a preliminary air monitoring study undertaken in order to idenitfy the composition of the gas emissions. These compounds are shown in Table 6. Concentrations of the gases at the vents ranged from 500 ug/m^3 to 10,000 ug/m^3. The majority of the compounds were detected in the surrounding environment at concentrations ranging from 100 ug/m^3 to 500 ug/m^3. These gases have the potential to degrade the quality of air and public health.

As part of ERT's effort in 1983 fencing was installed across the site access road to prevent vehicular traffic. This has left the majority of the site unsecured. Presently, trespassers on-site or individuals walking along Dunstable Road may come into direct contact with the leachate outbreaks. These are the only human receptors believed to be threatened by direct contact with the leachate streams.

While it is premature to draw any definitive conclusions relating to the extent of the long term off-site impacts until completion of the off-site Remedial Investigation it is not too early to implement a source control measure to reduce the ongoing impacts of 36 million gallons/year of leachate on the surrounding public health, welfare, or environment. It should be noted that while the data contained in Tables 1 through 6 indicate that there is a substantial ongoing impact to areas surrounding the site, that this landfill is relatively "young". Many of the hazardous substances were disposed of in the mid 1970's; it is believed that the currently detected compounds may not be totally representative of the wastes that may be ultimately discharged to the environment if no action is taken to minimize their release. There are a number of reasons for this belief; intact drums may not have degraded to the point of releasing their contents, contaminants may be perching in relatively impermeable zones within the landfill which over time may change due to natural settling, or solid toxic residues may solublize when exposed to solvents such as water. The estimate of 2,500 cubic yards of hazardous substances comes from scanty records by the landfill operator; the history of investigations of similar hazardous wastes sites indicates that available information is usually a small percentage of wastes ultimately found to be associated with a particular site.

Source Control measures such as capping and leachate collection are commonly employed at landfills and installation of them is justified at the earliest practicable date to minimize the public health threat or environmental damage from leachate streams, which by their very nature, are the most heavily contaminated sources likely to migrate from the site. The fact that there is an ongoing discharge of significant quantities of contaminated leachate and there exists a significant potential for additional contaminants to leach from the landfill argues for proceeding with the Source Control measures at this time. Source Control is aimed at significantly reducing the threat caused by the volume of leachate generated and the rate of transport off-site of such leachate. It is further aimed at reducing contamination of groundwater in the fractured bedrock aquifer which may be difficult if not impossible to extract. The cap is also aimed at reducing health threats from air emissions.

Enforcement

Attached is the list of potentially responsible parties currently identified by EPA for the Charles George Site (see attachment 2). The list has been developed as a result of title searches and responsible party searches for owners, operators, generators and transporters. The responsible party search for generators and transporters is still in progress.

In March of 1982 and again in May of 1983, Superfund notice letters were issued to the owners and operators of the site inviting them to participate in the Remedial Investigation/ Feasibility Study. Responses received from counsel on the behalf of the owners and operators have not indicated a willingness to undertake EPA's proposed clean up measures.

In January 1985, EPA sent a combination information request/notice letter to Karen Karras, as an operator and transporter, to which no reply has been received to date. EPA issued a combination information request/notice letter to Browning-Ferris, Inc. (BFI), inviting them to participate in the clean-up process, on December 10, 1984. The agency received a reply from BFI on March 6, 1985. In this reply, BFI did not indicate a willingness to undertake cleanup measures.

On October 3, 1983, EPA issued an information request letter to the Charles George Reclamation Trust (CGLRT). CGLRT responded only by providing available public waste manifests, which did not indicate the identities of any generators.

In January, 1985, EPA sent informational requests letters to the site owners and generator, Charles George, Sr., Charles George, Jr., Dorthy George, and James George and to a transporter, the Charles George Trucking Company. EPA has not received a reply to any of these requests.

The Coast Guard is a generator in this case. On January 29, 1985, EPA issued a Superfund notice letter to the Coast Guard. The Coast Guard responded on March 12, 1985, expressing an interest in pursuing the possibilities of participating in a portion of the clean up process for which they were responsible. However, it is not possible to determine this portion until other PRP generators are identified.

As a result of the response or lack of response received by the agency from the PRP's, The EPA has not been able to hold negotiations with any of the the PRP's regarding PRP participation in the RI/FS process. The Agency intends to open negotiations again for the PRP participation during the construction phase of the source control remedy. However, the Agency has recommended the use of fund monies to proceed with the RI/FS until the Agency is able to identify PRP's who are interested in undertaking the clean-up.

The case was referred to the EPA Headquarters in December 1984, to begin cost recovery actions against all recognized owners and operators to date.

On June 14, 1985, a complaint was filed in the Federal District Court for the District of Massachusetts against the Charles George Trucking Company, Charles George Sr., Dorothy George, Charles George Jr., and James George for the 1.7 million dollars spent by the EPA on responding to the site conditions thus far. The complaint also seeks to compel these defendants and another defendant, Karen Karras to respond to requests by EPA for information regarding wastes which were dumped at the site. Finally, the complaint sought and Federal District Judge Arthur Garrity granted on June 21, 1985 an injunction preventing defendants from conveying nearly two million dollars worth of real estate held by them.

Alternatives Evaluation

The purpose of this ROD and the Source Oriented Feasibility Study is to address source control measures in accordance with 40 CFR 300.68 (e)(2). An additional ROD for off-site actions in accordance with 40 CFR §300.68 (e)(3) (those areas outside the actual landfill) will be developed when the Phase III RI/FS is completed.

The objective of the source control measures is to abate the continued release to the environment of large quantities of leachate containing hazardous substances and to further minimize the threat to public health and other environmental concerns such as wetlands.

The Source Control measures are intended to be the second of three operable units and will be consistent with the final remedies contained in the Phase III RI/FS (i.e. the source control measures are not temporary in nature and will not need to be reconstructed to be compatable with the final remedy). Indeed, this second operable unit will probably mitigate the level of any final off-site remedial action.

Specifically, the objectives of the source control measures are:

- Abate additional impact to surrounding surface waters and wetlands.
- Minimize, to the extent practicable, continued release to the groundwater.
- Control the emission of gases containing hazardous constituents to the surrounding residents.
- Minimize potential contamination of the water supplies and impacts on recreational uses around Flint Pond.
- Minimize potential exposure, via direct contact with leachate, to the surrounding public and wildlife.
- Secure the site to eliminate unauthorized access.
- To comply with existing federal, state, and local laws.
- Ensure a Consistency with any off-site remedial alternatives which may be selected in the third ROD as required by CERCLA § 101 (24).

A summary of the information used to select a source control remedy is listed below:

- the site has inadequate cover material to retard leachate generation. Many areas of the site still had exposed refuse and numerous erosion gullies continue to appear exposing refuse and enhancing the potential for direct contact. Those areas which were covered were only covered with a relatively permeable soil cover.

- Inadequate barriers (man made or natural) exists onsite to retard leachate generation and its subsequent off-site migration.

- An ineffective partial leachate recirculation system does little to retard off site migration of leachate. In fact, the recirculation system may enhance the potential for leachate to impact groundwater by maintaining a higher hydraulic head in the landfill. This system is presently inoperative.

- Substantial volumes of leachate and surface water runoff (36 million gallons/year) are being produced and are migrating off-site. (see Table 1 for list of contaminants).

- The nearest potable water supply closed down, due to elevated levels of volatile organic chemicals. Sampling results of potable water wells when compared with monitoring wells and leachate samples show many of the same constituents in similar concentrations.

- There are numerous areas of distressed vegetation in those areas where leachate is allowed to run off as observed during many site inspections.

- Air samples from gas vents indicate gases containing known human carcinogens are being emitted from the landfill. Strong odors are detected in residential neighborhoods under certain atmospheric conditions.

- The large size of the site (69 acres, 4 million cubic yards) and the lack of definition of possible hazardous waste disposal area preclude an off-site removal and disposal option.

The Source Control Feasibility Study evaluated a total of eight possible alternatives. These alternatives were developed and evaluated using §300.68 (g), (h), and (i) of the NCP. The following alternatives were selected as remedial actions to be evaluated as source control measures.

I. No Action
II. Partial Soil Cap
III. Partial Clay Cap
IV.Partial Synthetic Membrane Cap
V. Full Soil Cap
VI. Full Clay Cap
VII. Full Synthetic Membrance Cap
VIII. Complete Off-site Removal and Disposal.

Each alternative, with the exception of the No Action and completed removal alternatives evaluated the following major components as part of the alternative. (see attached conceptual design which further describes these components).

- Site regrading and capping techniques - Portions of the landfill have side slopes steeper than the commonly accepted 3:1 ratio. Each alternative evaluated different techniques and material to obtain the appropriate slopes. In addition, different types of cover materials were evaluated against cost, quality assurance of material, and ease of installation. The evaluation of these items appears in more detail in the Source Control Feasibility Study.

- Surface/storm water collection and diversion - Surface water control will be required to facilitate expedient removal of uncontaminated rainfall from the site. Each alternativ will have, as part of its design, a surface water control system installed around the site to collect precipitation which was not uptaken by the roots of the vegtative cover. The control system will transport the surface water to areas off site. These areas will be designed to promote a wetlands area and will be used to compensate for any lost wetlands as a result of the remedial alternative.

- Gas collection and Venting - Presently the site emits gases to the ambient environment through cracks, fissures, vents, and the permeable soil cover. These gases contain volatile organic compounds, some of which are known human carcinogens (vinyl chloride, benzene). A detailed air sampling survey will be completed during the design phase of this project to determine if gas treatment will be needed. In the meantime these gases will collect and exert increased pressures on the underside of the impermeable cap which will need to be controlled and minimized. The method used to ensure that trapped gases do not cause a problem is to equalize the pressure by venting the gases to the atmosphere or a treatment system. Presently there is not adequate data to determine if a treatment system will be required; efforts are underway to gather the necessary information.

Each alternative incorporates a gas collection and venting system to ensure that trapped gases are not a problem. The alternatives evaluate a gas collection system which collect the gases under the cap through a permeable media. This media chanels the gases to a number of vents (between 12 and 24 depending on alternative). These vents will vent the gases to the atmosphere, untreated, until a determination can be made on treatment. The vents will be designed to easily incorporate a manifold collection system to carry to gases to a central treatment location, if necessary.

- Leachate Collection - Leachate will still tend to migrate off-site via break-out and shallow groundwater even after the installation of an impermeable cap. This leachate will be intercepted by a peripheral leachate collections system. This system will consist of a slotted pipe buried in a trench backfilled with crushed stone. The pipe will collect leachate, transport it via gravity to two collection sumps. Once the leachate is contained within these sumps it can be recirculated, trucked off-site to a Publicly Owned Treatment Works (POTW), or as to the long term method of disposal will be addressed during the Phase III RI/FS. Camp, Dresser and McKee (CDM) will evaluate feasible alternatives for leachate disposal prior to the completion of the Phase III RI/FS. Each alternative will have the same leachate collection system.

- Disposal of Remaining Above Ground Structure - There is a maintenance building remaining on site as well as a number of abandoned dumpsters. The maintenance garage will be used for storage of materials and supplies during and after the completion of the remedial actions. The remaining dumpsters will be either sold as scrap or dismantled and buried on-site.

The different capping alternatives are depicted in Figure 3. Also shown in Figure 3 is the proposed surface water control structures. Figure 4 shows the different cross-sections used in the capping alternatives.

It should be noted that the data collected during the ongoing RI/FS indicates that shallow groundwater may intersect parts of the bottom of the landfill and would produce a certain amount of leachate regardless of which alternative is selected. Because existing information also indicates that the bedrock, in which the bulk of the groundwater contamination appears to be flowing in, is highly fractured with the deeper fractures (400+ ft. below grade) being the ones contaminated, alternatives such as slurry walls and establishing artifical groundwater gradients were not evaluated as part of the source control measures. This remaining

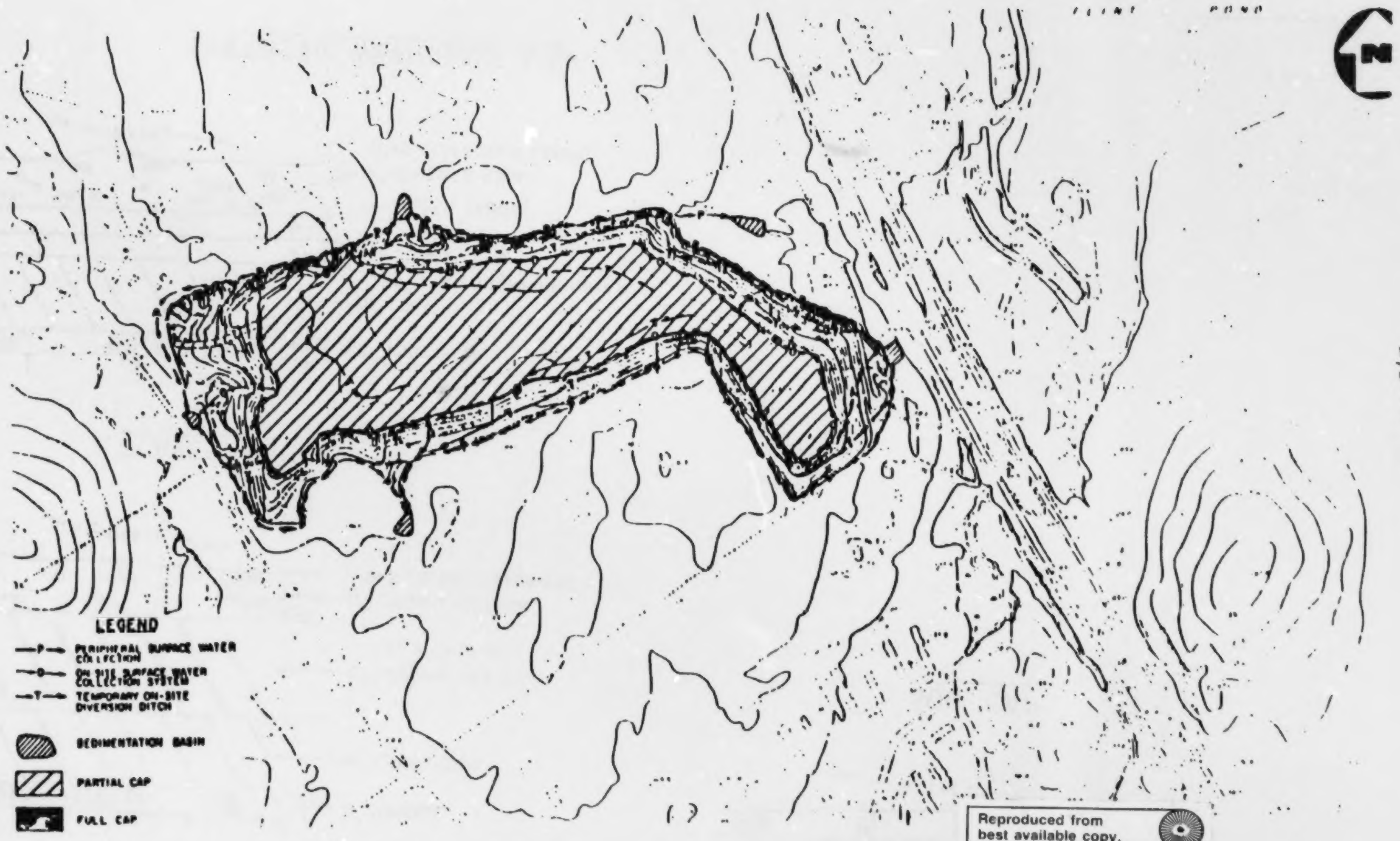
FLINT POND
N
LEGEND
—P→ PERIPHERAL SURFACE WATER COLLECTION
—O→ ON SITE SURFACE WATER COLLECTION SYSTEM
—T→ TEMPORARY ON-SITE DIVERSION DITCH
SEDIMENTATION BASIN
PARTIAL CAP
FULL CAP

Figure 3

LANDFILL CAPPING OPTIONS-PLAN VIEW-AND
CONCEPTUAL SURFACE WATER CONTROL PLAN
CHARLES GEORGE SITE, TYNGSBORO, MA
SCALE: 1"=400'

400 0 400
SCALE IN FEET

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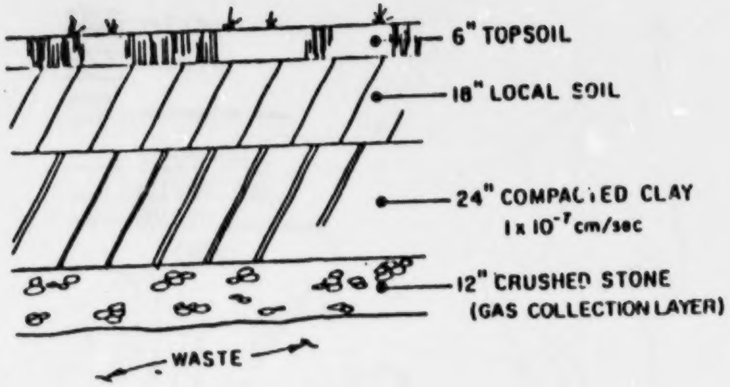
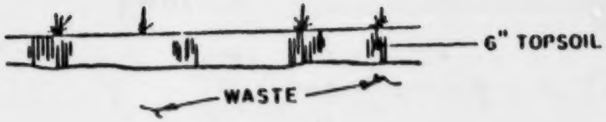
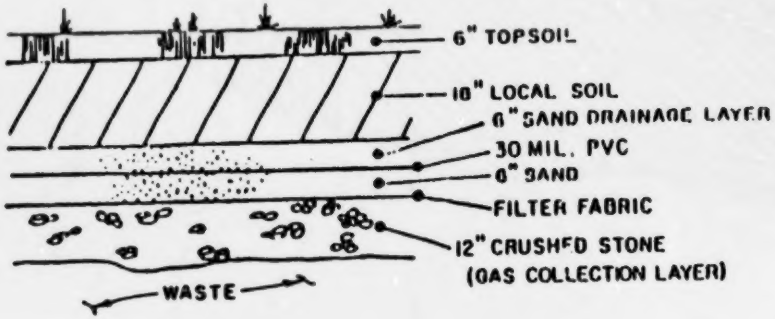
Figure 3


6" TOPSOIL
18" LOCAL SOIL
24" COMPACTED CLAY
1 x 10^{-7} cm/sec
12" CRUSHED STONE
(GAS COLLECTION LAYER)
WASTE

CLAYEY SOIL CAP


6" TOPSOIL
WASTE

SOIL CAP


6" TOPSOIL
18" LOCAL SOIL
6" SAND DRAINAGE LAYER
30 MIL. PVC
6" SAND
FILTER FABRIC
12" CRUSHED STONE
(GAS COLLECTION LAYER)
WASTE

SYNTHETIC MEMBRANE CAP

LANDFILL CAPPING OPTIONS - TYPICAL SECTIONS
CHARLES GEORGE SITE, TYNGSBORO, MA
NOT TO SCALE

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amount of leachate will be addressed as part of the off site remedial alternatives.

Initial Screening of Alternatives

Each alternative was evaluated for compliance with 40 CFR §300.68 (h)(1), (2), and (3). Specifically, each alternative was screened on the basis of cost, environmental effects of the alternative, and acceptable engineering practices. Each was also evaluated for consistency with any remedial alternative which could result from the third operable unit in accordance with CERCLA §101 (24). The first step in the initial screening evaluated the public health and environmental effects. Each alternative was evaluated for the reduction of the potential public health and enviromental risks and for whether the alternative is sufficient to achieve adequate control of source problems as required by §300.68 (h)(2) of the NCP. Preliminary cost screenings followed next and served as a basis for the elimination of alternatives that far exceeded the cost of other alternatives but did not provide substantially greater public health or environmental benefit. (see Table 7). Effects of the alternative evaluation addressed adverse short-term impacts against long term gains. The acceptable engineering practices section evaluated items such as quantities of materials, needed, implementation timeframe, short term impacts, and reliability of chosen alternative. Finally, each alternative was evaluated for consistency with any proposed off-site remedial action.

The following alternatives were effectively eliminated from further consideration as a result of the initial screening:

No Action Alternative (Alternative I)

The No Action Alternative has the least cost of all the alternatives evaluated, the only costs being monitoring costs. This alternative would allow the site to remain in its present state. The large volume of leachate and surface water would continue to impact the surrounding public health and environment. Because of the nature of the fractured bedrock it is very difficult to accurately predict groundwater movement and as a result it is likely that additional wells may be contaminated in the future, especially if the rate of leachate production is allowed to continue unabated. The No Action Alternative would not prevent a continuation and futher expansion of the erosion gullies with their subsequent potential for direct contact and/or release of additional contaminants to the environment. In summary, the No Action Alternative would not be likely to achieve adequate control of source material as required by §300.68 (h)(2) of the NCP.

While off site remedial measures are the subject of the Phase III RI/FS and a third ROD, a critical component of any off site

Table 7

Order of Magnitude Cost Comparison of Remedial Alternatives
Charles George Site
Tyngborough, Massachusetts

Alternative		Present Worth Cost Estimate (1985 Dollars)			
		10^6	10^7	10^8	10^9
I	No Action	X			
II	Partial Soil Cap	X			
III	Partial Clay Cap		X		
IV	Partial Synthetic Membrane Cap		X		
V	Full Soil Cap	X			
VI	Full Clay Cap		X		
VII	Full Synthetic Membrane Cap		X		
VIII	Complete Removal				X

Source: NUS Corporation, Pittsburgh, Pennsylvania (March 1985)

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remedial measure is the elimination or minimization of an ongoing source of contaminants. The No Action Alternative would not provide this critical component. The source would continue to introduce large quantities of contaminants into the environment including the wetlands. As a result, the No Action Alternative was eliminated from futher consideration because of its failure to achieve adequate control of source materials as required under 40 CFR §300.68 (h)(1),(2), or(3).

Complete Removal and Off-Site Disposal (Alternative VIII)

This alternative seeks to control further off site contamination by removing the source i.e. the landfill itself. Aside from the two orders of magnitude cost differental, this alternative presents a number of technical concerns which eliminates it from further consideration. The landfill contains approximately 4 million cubic yards of refuse and hazardous substances. In order to remove this massive amount of material, NUS Corp. estimated that it would require approximately 226,000 truckloads over an eleven year period of time to complete this task. Non-hazardous refuse would be trucked to the nearest available landfill or resource recovery operation and the material deemed to be hazardous would need to go to the nearest permitted RCRA facility (probably upstate New York). This alternative would create numerous short term environmental impacts to the surrounding areas, such as significant odor and traffic problems, releases of sediments to wetlands, etc. It is questionable whether such an operation could be undertaken safely. There is a significant potential for a fire or explosion resulting from the use of construction equipment, or spontaneous combustion, due to the presence of methane from the disposal of organics and anerobic decomposition of the landfill wastes. This alternative was eliminated from further consideration on the basis of adverse environmental impacts and on the basis of cost. The Source Control Feasibility Study calculated that complete removal and disposal of the landfill materials would cost two orders of magnitude more than the next acceptable alternative. (see Table 7) Therefore this alternative was excluded from further consideration because of requirements in §300.68 (h)(1) and (2) of the NCP.

Detailed Analysis of Alternatives

The remaining six (6) alternatives were further screened according to CERCLA guidance which requires that this screening process be consistent with 40 CFR Part 300.68(i) (see Table 8). The six (6) alternatives were screened first using non-cost criteria, which includes " Technical Feasibility", "Institutional Requirements", and "Public Health and Environmental" factors. Next, detailed cost estimates were developed in order to compare the alternatives on the basis of cost of implementation.

Partial Soil Cap (Alternative III)

The Partial Soil Cap Alternative would place a six inch cover of local soils on the landfill. The cover would extend from the crest of the landfill down the side slopes to an elevation of 225 feet above mean sea level (MSL). Sections of the landfill would be regraded to facilitate surface water runoff; the cover would be seeded to establish vegetation; and a leachate collection system along the toe of the landfill would be installed. The intent of this alternative is to retard percolation of precipitation into the landfill by maximizing surface water runoff and uptake of moisture by the root system. The elevation of 225 ft. MSL was selected based primarily on two factors. The slopes of the landfill sides below 225 ft. MSL increase substantially (less than 3:1) and when the landfill is viewed cross-sectionally it can be determined that the reduction in area potentially impacted by precipitation versus the much larger area under the cap substantially decreases below the elevation of 225 ft. MSL.

The advantages to this alternative is its relatively low cost and short implementation timeframe. The disadvantages are that a substantial amount of precipitation would be permitted to percolate into the landfill either through the relatively permeable soil used as the cover material or through the exposed area below the elevation of 225 ft. MSL. In addition, the area not covered could provide a direct contact problem. With a design thickness of six inches, the potential for erosion gullies to appear and futher expose refuse is significant. This alternative would permit leachate to continue to impact the wetlands as a result of soil erosion and leachate flowing into them.

Partial Clay Cap and Partial Synthetic Cap (Alternatives III and IV)

These two alternatives are similar to Alternative II except that the capping material is relatively impermeable (10^{-7} cm/sec). NUS Corp. estimates that these alternatives would reduce leachate migration by approximately 50 percent.

These alternatives would produce similar environmental impacts as the pervious alternative except that surface erosion below the cap may be more pronounced (precipitation would parallel the interface between the impermeable layer and the soil overburden instead of continuing downward into the landfill and would break out when the cap ended). This problem may be eliminated by a more substantial surface water collection/diversion system.

These alternatives are feasible and have a positive effect on the environment, however both would permit large quantities of leachate (18 million gallons/year) to migrate off site and impact the surrounding area. Similar impacts to the wetlands as Alternative II can be expected. They also will have the same problems as Alternative II below the end of the cap. In addition these alternatives would not minimize nor control air emissions from the uncapped area.

Alternatives II, III, and IV do not meet the applicable state standards for landfill closure nor do they meet the requirements of 40 C.F.R. §264 Subpart G and 40 C.F.R §264.310 Subpart N.

Full Soil Cap (Alternative V)

This alternative is similar to Alternative II (partial soil cap); the major differences are that this alternative extends the soil cover past the 225 ft. MSL elevation to the toe of the landfill and that the amount of material needed to complete this alternative is substantially greater. The partial soil cap estimated 24,050 cubic yards were required to complete the task while this alternative estimates that 174,050 cubic yards are needed. This alternative would also require substantial site regrading on the lower slopes to obtain a slope of 3:1. This alternative is technically feasible and would provide an improvement to the surrounding environment. It would, however, permit a substantial amount of leachate to still be produced as a result of the relative permeability of the local soils. This alternative as well as Alternative II would do little to prevent refuse from becoming exposed at the surface or control continued leachate break out as a result of the freeze-thaw cycle typical of the region. The impact to the wetlands would be minimized, however there would still be considerable leachate entering the wetlands.

Full Clay Cap (Alternative VI)

This alternative is conceptually the same as Alternative V except for the type of cover material used. This alternative uses a two foot thick impermeable clay (10^{-7} cm/sec) has its cover material. The clay acts as an umbrella to shed the water from reaching the contents of the landfill, directs the water to a surface water diversion channel, and off site. This technique effectively eliminates precipitation from interacting with the contents of the landfill and producing leachate.

This alternative is capable of meeting the response objectives, is technically feasible, and produces a net positive impact on the environment. The major drawback to this alternative is the amount and availability of clay necessary to complete the job. Camp, Dresser, and McKee (CDM), as part of a pre-design task, evaluated possible clay sources and other alternatives, such as benonite or sprayed bituminous membrane. CDM rejected the use of the latter techniques as being cost prohibitive when compared to a synthetic membrane liner (Alternative VII). CDM's investigation of possible clay sources indicates that there is an insufficient amount of clay with a permeability of 10^{-7} cm/sec available. The closest source was in Exeter N.H. however the clay only reached the required permeability at 100% compaction (100% compaction is not technically practicable given the conditions found at large landfills). The impact to the wetlands are substantially minimized as a result of elimination of leachate and surface water runoff.

Full Synthetic Membrane Cap (Alternative VII)

This alternative is similar to Alternative VI except that it uses a High Density Polyethylene (HDPE) membrane to provide the impermeable layer instead of the clay. This alternative meets all the response objectives, is technically feasible, and has a net positive effect on the surrounding public health and environment. It is less expensive than Alternative VI, $17,423,000 versus $22,047,000, and does not have some the problems inherent with the use of clays. In addition, less fill material is needed to complete the project and the project is not as dependent on weather conditions, as is clay. As in Alternative VI impacts to wetlands will be substantially minimized.

Alternative VII, which is the recommended source control remedial measure is consistent with any off site remedial measures that may be reasonably evaluated. This is demonstrated by the following:

1. Standard engineering practice calls for capping landfills;
2. The cap will not have to be removed or replaced to implement off site remedies;
3. Reduced leachate generation will minimize off site migration of hazardous substances;

Table 8 shows the various costs associated with the alternatives considered in the final screening.

Community Relations

Appended to the ROD is the Responsiveness Summary (attachment 3), the Executive Responsiveness Summary (attachment 4), and the Responsiveness Summary History (attachment 5).

These documents summarize the community's and PRP's concerns and EPA's responses and the state's comments regarding the entire project; Phase I - Installation of the waterline, Phase II Source Control Remedial Action, (capping of landfill for site closure), and Phase III - Off-Site contamination and any unresolved issues developed during Phase I or Phase II.

TABLE 8

CHARLES GEORGE LAND RECLAMATION TRUST LANDFILL
TYNGSBOROUGH, MASSACHUESTTS
REMEDIAL ALTERNATIVE

Alternatives	Capital ($ mil)	Present Worth ($ mil)	Public Health Considerations	Environmental Considerations	Technical Considerations	Public Comment
No Action	----	0.92	Unacceptable. Potential for direct contact with exposed wastes and leachate. Potential threat to City of Lowell's water supply if presistent compounds are released.	Continued production of leachate and contamination of surface and groundwater. Additional water supply wells may be impacted.		Strong public resistance.
Partial Soil cap.	2.5	4.0	Reduces amount of exposed wastes. Does not minimize air emissions and only partially reduces amount of leachate generation.	Still signiificant impact to surface and groundwater. Continued degradation to wetlands.	Uses common construction techniques.	Unacceptable to public.
Partial Clay	8.8	10.3	Still permits a substantial release to groundwater with subsequent contamination of water supply wells.	Provides a greater reduction in leachate generation than previous alternative.	Uses common engineering practices - more difficult to implement than Alternative II.	Unacceptable to public as they preceive it as only half a resolution.

Alternatives	Capital	Present Worth	Public Health Considerations	Environmental Considerations	Technical Considerations	Public Comment
IV. Partial synthetic membrane cap.	7.2	8.7	Similar to previous alternative.	Similar to previous alternative.	Similar to previous alternative.	Similar to previous alternative.
V. Full soil cap.	4.9	6.5	Covers all exposed refuse. Does not minimize air emmission.	Still permits a substantial amount of leachate to be generated with its impact on the surface and groundwater.	Common engineering practice.	
VI. Full clay cap.	16.8	18.4	Reduces potential threat to groundwater and surfaces to extent practicable.	Minimizes leachate generation. Controls release of air emmissions.	Uses common engineering methods.	Preceived as desirable by community.
VII. Full synthetic Membrane cap.	13.6	15.2	Similar to Alternative VI.	Similar to Alternative VI.	Uses common engineering techniques.	Perceived as desirable by community.
VIII. Complete removal.	104	965	Causes major short term impacts to public health and environment.	Alternative may produce more harm than good as contaminants may be released during excavation.	Technically feasible however not practiable due to large. number of vechicles and amount of time to complete task.	Preceived by community as causing to much disruption to local area.

In general, the publc recommended that a full cap of impermeable material along with the necessary components to control the migration of leachate and air emmissions from the landfill be implemented, as soon as possible. Residents recommended that drummed hazardous waste be removed before construction of the cap. Some community residents in the Flint Pond areas suggested that more concentration be placed on controlling soil erosion during construction into Flint Pond Marsh via the Route 3 culvert. These source control technologies are offered by Alternatives VI - Full Clay Cap and VII - Full Synthetic Membrane Cap.

The Dunstable Town Board of Health Summarized its concerns in three areas: (1) They would like more testing of the aquifer on the West side of the landfill, (2) Insure capture and removal of the organic gases from the landfill, and (3) a complete capping of the landfill with a material of the low permeability. Answers are contained in the Responsiveness Summary, attached.

The state selected Alternative VI and VII as their recommendation. The determining factor for their final recommendation of either Clay or Synthetic Membrane Cap was the availability of a clay source.

CONSISTENCY WITH OTHER ENVIRONMENTAL LAWS AND REGULATIONS.

Environmental laws which may be applicable or relevant to the source control action proposed are as follows:

- Resource Conservation and Recovery Act (RCRA), Part 264
- Executive Orders 11990 (Wetlands) and 11988 (Floodplain) Guidance outlined under 40 CFR Part 6, Appendix A.
- Clean Water Act
- Clean Air Act
- Safe Drinking Water Act

The proposed alternatives were reviewed for consistency with applicable RCRA technical standards, specifically 40 C.F.R. §264 Subpart G entitled Closure and Post Closure and 40 C.F.R. §264.310, Subpart N, Landfills entitled Closure and Post Closure Care. The cap will be designed in accordance with Section 264.310(a):

1) Provide long-term minimization of migration of liquids through the closed landfill.

2) Function with minimum maintenance.

3) Promote drainage and minimize erosion or abrasion of the cover.

4) Accomodate settling and subsidence so that the cover's integrity is maintained.

5) Have a permeability less than or equal to the permeability of any bottom liner or subsurface soils.

The cap installation will be performed as specified in § 264.303. The landfill will be surveyed and a notice will be placed in the deed and to the local land authority as specified in § 264.119 and § 264.120. The applicable closure requirements in § 264 Subpart G will be addressed. (Decontamination/Disposal of Equipment, Certification by Professional Engineer, and Site Security will be provided as specified in § 265.117(b)). Post Closure Care and groundwater monitoring will be performed in accordance with 40 C.F.R. 264 Subparts F and G and Subpart N 264(b).

Wetlands Impacts

As noted previously, a preliminary Wetlands Assessment was performed and is appended to this ROD. Alternatives in the Source Control Feasibility Study were evaluated for possible wetlands impacts in accordance with Section 2 of the Executive Order 11990. The assessment determined that impacts to the wetlands as follows: No Action - this alternative would not eliminate any wetlands however the leachate would continue to impact the wetlands unabated. Complete Removal - this alternative would effectively eliminate the wetlands adjacent to the site on the short term, however the potential for restoring partial wetlands to the 69 acres could be part of the remedy. The remaining alternatives (II-VII) will have similar impacts on the adjacent wetlands with the exception of varitions of leachate impact. All of these alternative will require the installation of a leachate collection system. This system will destroy a relatively small wetlands (on the north side of the landfill) however the pre-design of the cap will compensate for the loss of this particular area by establishing a larger wetlands to the south of the site. As described previously the only alternatives which will significantly reduce quantities of leachate generated by the landfill are the full capping options. As the following section describes the recommended option will be a full impermeable cap.

As has been repeatedly discussed throughout this ROD, off site wetlands impacts will be additionally evaluated in the Phase III RI/FS.

Since the source control remedy is not considered a final remedy, but rather is considered to an operable unit in the final remedy, EPA is not addressing the issue of groundwater remediation. This is to be studied in Phase III of this project regarding offsite contamination.

Recommended Alternative

As shown in Figure 3, Alternative VII is a full synthetic membrane cap with surface water diversion and collection, a full peripherial leachate collection system, gas collection and venting, and establishment of 3:1 grades where required. This alternative is the one recommended by EPA as "the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare, or the environment" 40 C.F.R. §300.68 (j).

Alternative VII, as stated previously, meets applicable and relevant local, state and federal regulations for site closure (40 CFR 264 subpart G and N) and CERCLA regulations as set forth at 40 C.F.R. §300.68 of the NCP. Alternative VII is acceptable to the public.

As has been stated throughout this ROD, the selected alternative is for source control and is not the final remedy which will address off site contamination and will be the subject of another ROD.

A tabulated summary of annual operation and maintenence (O&M) costs and capital costs with description of each for Alternative is given below.

O&M Costs for Recommended Alternative

- Cap	18,235.00
- Peripheral Leachate Collection System	23,577.00
- Gas collection system	5,340.00
- On-site surface water collection system	13,100.00
- Temporary on-site diversion system	9,000.00
- Renovation cost component	10% of capping

Note: (Figures assume a major renovation will be necessary to cap during post-closure period)

CAPITAL COST FOR RECOMMENDED ALTERNATIVE

Component Costs	Basic Costs	Present Worth
Cap	11,836,494	15,442,000
Temporary onsite surface water diversion		41,101
On site surface water collection		264,189
Peripheral surface water collection		194,532
Leachate collection		833,439
Gas collection system		332,631
Dumpster clearing and removal		111,339

O & M activities associated with the implementation of Alternative VI are as follows:

- Annual mowing and maintanence of the vegetated surface.
- quarterly inspection of the following:
- pump station
- leachate collection/recirculation system
- cap surface.

State Role

The state's role in this federal lead site is multiple. The state reviews documents to determine whether they are in compliance with existing state laws. The state will provide 10% of the costs of the on-site remedy and will assume reponsibility for the long-term O & M.

Milestones

List of key milestones for project implementation: - Complete enforcement negotiations Approve Remedial action (sign ROD) - Award Superfund state contract (and IAG) for design - Start design - Complete design - Award/Amend Superfund state contract (and IAG) for construction - Start Construction - Complete construction

Future Actions

As noted previously the objective of this ROD is the implementation of source control measures. There are a number of issues relative to off-site impacts that will have to be resolved prior to the signing of the off-site ROD and its subsequent implementation.

These actions include;

- completion of the offsite RI/FS. Presently, the field portion of the RI has been completed. A risk assessment will be finalized. Review of the Existing data indicates that the landfill is significantly impacting groundwater and surrounding surface water. Data collected to date is inconclusive to define the extent of contamination in the fractured bedrock aquifer surrounding the site. Additional monitoring wells, sampling and analysis will be needed in order to reasonably characterize off-site groundwater alternatives. A similar effort will be required for the Flint Pond Marsh wetlands. A definitive scope of work for this additional effort has not been finalized.

- Development/signing of an off-site ROD. Based on information resulting from the completion of the Phase III RI/FS the agency will need to complete a ROD which minimizes and mitigates the migration of hazardous substances off-site. This ROD will also address any additional source contol issues that might need to be resolved as a result of the post closure monitoring program. - Development and Implementation of a Post Closure Monitoring Plan. As part of the design resulting from this ROD a post closure monitoring plan to determine the effectivenss of the source control measures will be developed. This plan, once approved, would be implemented, however, it is reasonable to assume that upon completion of an off-site remedial design another post closure monitoring plan incorporating and modifying sections of the previous plan to be more efficient, is prudent.

ATTACHMENT 1

Preliminary Wetlands Assessment for the Charles George Land Reclamation Trust Landfill, Tyngsborough, Massachusetts

On May 22, 1985, Richard Leighton, EPA Region I remedial site project officer, and Matthew Schweisberg, EPA Region I wetlands program staff, visited the Charles George Landfill site located in Tyngsborough, Massachusetts. The purpose of this site visit was to perform a preliminary assessment of the wetland areas both on- and off-site which may be impacted by remedial actions taken at the site. Assessments of this nature are based solely upon visual observations and typically include:

- a general characterization of wetland vegetation cover types;
- a general characterization of hydrologic features; and,
- an evaluation, based upon visual observations, of the level of disturbance to the wetland area from human-caused factors (typically referred to as degradation).

The resulting product of the investigation was to be a report assessing the potential impacts upon the wetland areas of the possible remedial alternatives as described in the draft source-oriented feasibility study (March 1985). That assessment follows.

Observations:

We began our visit on the north side of the landfill. A small wetland area (Area 1 on the attached map) was found that begins at the toe-of-slope and follows the landfill linearly for about 100 feet. This wetland area extends away from the landfill for about 75 feet, though its width only reaches about 70 feet at its widest part. The remaining wetland continues as a narrow strip about 50 feet long and it extends 10 feet away from the landfill. In total, the area encompasses approximately 4,000 square feet. Standing water was present and was about 2-4 inches deep in the center of the wetland. The principal source of this water appeared to be from landfill runoff. Plant species observed include cattail (Typha spp.), horsetail (Equisetum spp.), Blue flag (Iris versicolor), red maple (Acer rubrum), jack-in-the-pulpit (Arisaema stewardsonii), and black willow (Salix nigra). Although rust-colored leachate was evident in the water and an oily film was present on the water surface, a few green frogs were observed as well as some passerine bird species (red-winged blackbird) using this area. On the whole, this wetland area did not appear to be degraded despite the presence of the landfill.

The next wetland area (Area 2) that was found is located on the southwest side of the landfill. This area begins at the toe-of-slope and follows the landfill linearly for about 300 feet. It extends away from the landfill for about 1,000 feet as it gradually narrows down to a width of about 50 feet. In total, the area covers approximately 2-3 acres. Near the landfill, a vegetated area exists comprised primarily of cattail. The area then becomes open water (about 4 feet maximum in depth). The open water grades into a forested swamp, mostly covered in standing water of about 1-2 feet in depth. The source of the water was not readily evident. The forested area is comprised of red maple, yellow birch (Betula lutea), and in the areas not submerged, marsh fern (Dryopteris thelypteris), sensitive fern (Onoclea sensibilis), blue flag, and swamp-pink or pink lady's slipper (Arethusa bulbosa). While walking this area, we flushed 5 mallards. In addition, numerous aquatic insects were seen in the water. Some sign (tracks) of deer was observed also. This wetland area appeared not to be affected by the landfill.

Moving toward the western end of the landfill, we found two small streams (Area 3), one perennial and one intermittent. Both streams originate at the toe of the landfill and flow away from it. The intermittent stream eventually flows into the perennial stream. The intermittent stream, which was dry, is vegetated along its course

with small patches of blue flag and some skunk cabbage (Symplocarpus foetidus). The perennial stream had only a small volume of flow (about 1-2 cfs). Along its course it is vegetated with horsetail, blue flag, skunk cabbage, sensitive fern and red maple.

The perennial stream appeared to flow into a wet meadow (Area 4) behind an abandoned house (this property belongs to Mr. Charles George) which is adjacent the landfill. Eventually, water from the wet meadow flows to the west and enters Dunstable Brook. The wet meadow is comprised of some small black willow, sensitive fern, and purple looosestrife (Lythrum salicaria). This wet meadow covers an area of approximately 2,000 square feet. It is probably seasonally wet, however, there was no water evident while we were present. These streams appear to be unaffected by the landfill.

On the northwest edge of the landfill, a retention basin empties (through an underground channel or culvert (?)) into a stream (Area 5) which appears above ground on the opposite side of Dunstable Road. Leachate was evident in this stream until its confluence with Dunstable Brook approximately 100 feet from the roadway. At the confluence, the leachate is sufficiently diluted so as to make it visually undetectable. Dunstable Brook had a moderate volume of flow (approximately 5-10 cfs). The banks of the Brook's course are vegetated with yellow birch, black willow, red maple and various herbaceous species. Although flow was fairly rapid, large amounts of algal growth were evident in Dunstable Brook. Also, a duck (mallard?) was flushed just downstream of the confluence. Other than the leachate in the smaller stream coming from the landfill, no impacts upon the brook were observed.

Finally, we visited Flint Pond marsh (Area 6) which is located to the east of the landfill across Route 3. Flint Pond marsh is a large (>20 acres) emergent wetland complex primarily dominated by cattail. Other plant species present include purple loosestrife, yellow pond-lily (Nuphar variegatum) and black willow. Leachate from the landfill enters this marsh through culverts which run beneath Route 3. We observed that a fringe area of the marsh running linearly along the highway appears to be dying (browned-out from landfill and/or road salt impacts?).

Discussion:

According to the draft feasibility study, eight possible remedial alternatives exist for addressing clean-up of the landfill. These possible alternatives range from no action to partial capping to complete excavation and removal. The potential impacts of these alternatives upon the wetland areas are discussed below.

Obviously, the no action alternative would have no direct impact upon the wetlands other than to maintain the current situation. As this alternative would permit landfill leachate to continue to enter the wetland areas, long-term impacts might prove unacceptable.

Partial capping of the site, either with soil, compacted clay or a synthetic membrane would not directly impact the wetland. However, the activities associated with installation of the partial cap and leachate collection system would have definite impacts upon wetland areas 1, 2, and 3. Strict sedimentation and erosion control measures would be required to minimize these impacts.

A full cap would have a direct impact upon wetland areas 1, 2 and 3. To achieve proper side slopes for the cap, placement of fill probably would eliminate most or all of area 1. As the slope of the landfill is more gradual by areas 2 and 3, only a small portion of these areas might need to be filled for placement of the cap.

In addition, with installation of a leachate collection system surrounding the landfill at the toe-of-slope, the possibility of eliminating the primary source of water for areas 1 and 3 would be high. As the source of water for area 2 was not evident, it is unclear what impact the leachate collection system would have on this wetland area. Further, elimination of the primary source of water for area 3 might impact area 4, although area 4 is located some distance from the landfill and the level of such an impact is unknown. Capping and installation of a leachate collection would eliminate the leachate stream (area 5) running from the on-site retention pond to Dunstable Brook. As a full cap would remediate the problem adequately, it probably is a viable alternative.

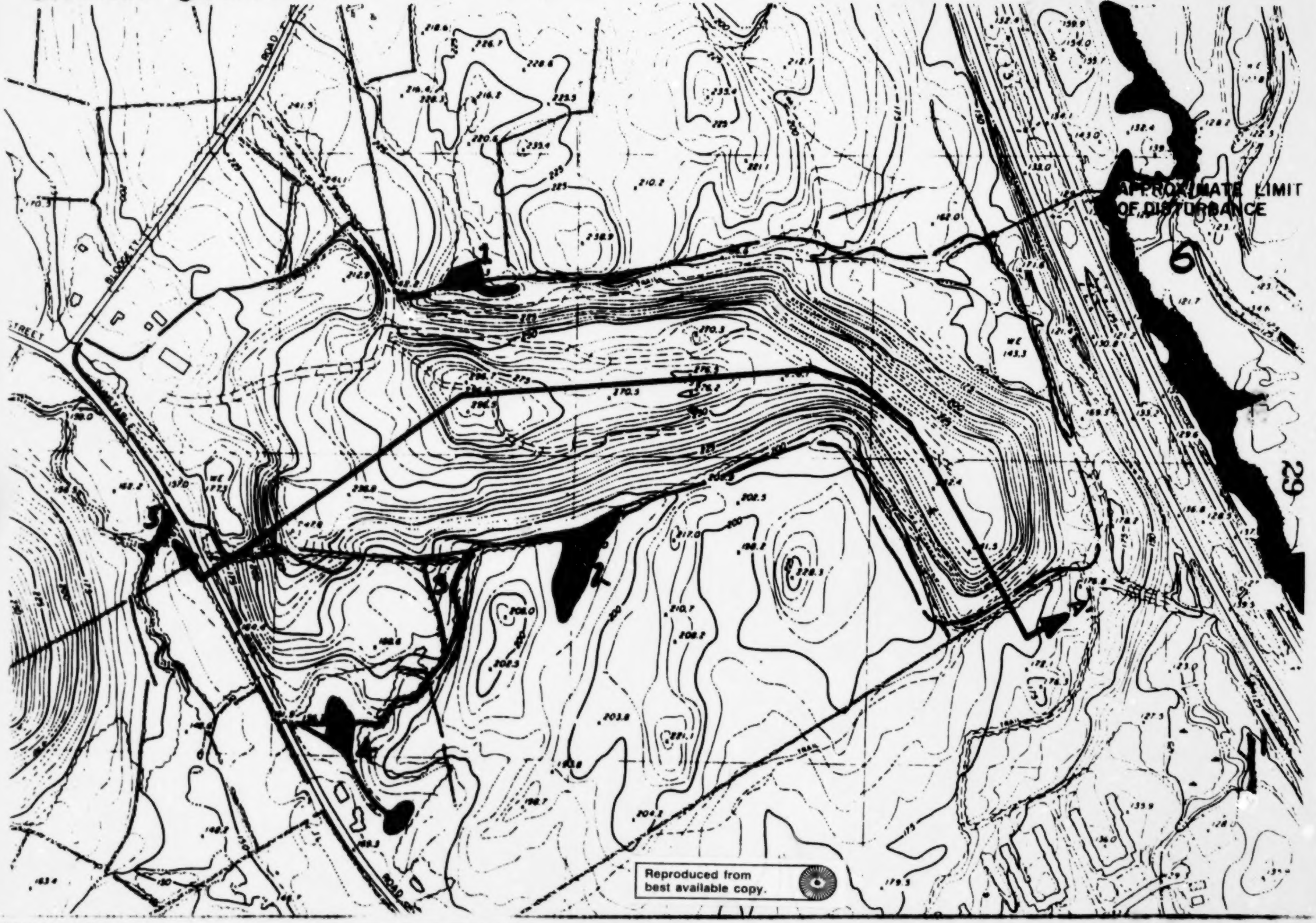
Complete excavation and removal of the landfill would result in significant disturbance to wetland areas 1, 2, 3, and 5, even if care was taken regarding erosion and sedimentation controls. In all likelihood, areas 1, 2 and 3 would be effectively eliminated. Although this alternative would meet RCRA requirements, the impacts upon the wetlands clearly are more significant than those from installation of a full cap.

Conclusions and Recommendations:

Full capping appears to be the most preferable alternative from a wetlands impact perspective. Although areas 1 and 3 probably would be eliminated, these areas are small and relatively insignificant. Area 2, the only wetland of significance which would be directly impacted, probably would not suffer greatly particularly if the landfill could be cut back where it abuts area 2 prior to capping. In addition, careful erosion and sedimentation controls would need to be implemented. Further, Area 5 could be used to mitigate the probable loss of areas 1 and 3. Area 5 could be extended and widened at its far end away from the landfill, possibly including placement of a water control structure to maintain adequate water level within the wetland. However, in terms of mitigating for these wetland impacts due to the source control remedial measures, development and implementation of an actual mitigation plan should be delayed and addressed as an integral part of phase III, the remedial investigation and feasibility study which will address off-site contamination.

While performing the phase III RI/FS, a more thorough and detailed wetlands assessment should be performed. This additional assessment should include a more thorough characterization of the vegetation, hydrology, soils and wildlife present in the wetland area (or those that remain). Based upon this more detailed assessment and the potential off-site remedial alternatives, an adequate wetland mitigation plan can be developed.

CHARLES GEORGE LF - NOT TO SCALE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ATTACHMENT 2

'1.

List of Potentially Responsible Parties for the Charles George Reclamation Trust.

Charles George, Sr.
Tyngsborough, MA.

Dorothy George
Tyngsborough, MA.

James George
Tynsborough, MA.

Karen Karras
Ipswich, MA.

Charles George, Jr.
Tnysborough, MA.

Charles George Trucking Co.

U. S. Coast Guard
Boston, MA.

Browning- Ferris Industries
Tyngsborough, MA.

attachment 3

NUS CORPORATION
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RESPONSIVENESS SUMMARY

CHARLES GEORGE SITE
TYNGSBOROUGH, MASSACHUSETTS

EPA WORK ASSIGNMENT NO. 54-1L16.2
NUS PROJECT NO. 5766 (0766)
JUNE 1985

TEM NO.	ISSUE / CONCERN	RESPONSE
1.a.	**GAS EMISSIONS/PUBLIC HEALTH** Organic compounds are escaping to the air around the site; the odor is noxious, especially during heavy fog. Is there any program planned to study the effects on children or commuters in the local area? These individuals may be particularly susceptible to the gases, since they typically must stand for extended periods of time waiting for buses?	During the Remedial Investigation field study, an attempt was made to identify the landfill gas composition. Samples were taken directly from the landfill gas vents in July 1984 to determine the composition of landfill gases. On October 19, 1984, samples were again taken from the vents, as well as upwind (northwest of the site) background points, points between the landfill and the Cannongate Condominiums, and from points near the Cannongate buildings. It must be emphasized that the October sampling was not an attempt at a definitive atmospheric study, but merely an attempt to determine relative concentrations of volatile organic compounds within the vents and the surrounding area. The results demonstrated that on October 19 the number of volatile organic contaminants and their respective concentrations

ATTACHMENT 3

EM IO.	ISSUE / CONCERN	RESPONSE
		No detailed atmospheric study has been done at the site to date. Additional studies will be done by CDM in order to define rates of flow and concentrations of constituents in gases emitted from the landfill. These studies, however, will be directed toward defining parameters useful in designing the landfill venting system, and will not be directly applicable to evaluation of health risk. At the present time, the need for more specific studies to evaluate the potential health risks associated with breathing the air around the landfill is being studied by the EPA. It is a known fact that under certain atmospheric conditions (e.g., inversions), the air quality in the site area is characterized by a noxious odor.

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RESPONSIVENESS SUMMARY CONTINUATION

CHARLES GEORGE SITE
TYNGSBOROUGH, MASSACHUSETTS
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		The present plan will be to prevent landfill gases from being released directly to the air by installing a gas venting system. Approximately 17 gas vents have been suggested with the full capping option. Each of these vents could be fitted with its own treatment unit, or individual vents could be tied together via a manifold system with centralized treatment. CDM will evaluate the number, size and location of vents required, and will further study alternative treatment schemes.

M).	ISSUE / CONCERN	RESPONSE
b.	Have you looked at harmful effects from the gases emitted from the landfill; have you considered harmful effects individually and in combination?	The air sampling done to date was intended only as a preliminary investigation, not necessarily designed to define whether a public health threat exists at the site. As such no one can expect a definitive response to the question of potential off-site public health impacts via inhalation of gases from the landfill. However, the Charles George Site Remedial Investigation Report will contain a chapter devoted to defining present and potential health risks associated with uncontrolled movement of contaminants from the site to the surrounding area. The air quality data will be reviewed with respect to the specific species of gases present. Within the constraints of the data, given its qualitative nature, discussion will be provided which will consider additive potential health effects of each compound. Considering their effects to be additive, although this may not be the actual case, is a conservative approach which follows EPA guidance.

M).	ISSUE / CONCERN	RESPONSE
.c.	Will the gases continue to be released into the air, or will they be vented or collected onsite?	In connection with each of the remedial alternatives identified in the Source-Oriented FS Report, gases will be collected via a venting system. Collection of gases in this manner provides the opportunity for their treatment prior to being discharged to the atmosphere, either at each vent location, or at a common location with all or a portion of thee vents tied together through a system of piping. The decision to implement treatment has not yet been finalized. Additional studies may be done in conjunction with the study of off-site remedial actions (Phase III), which would be useful to EPA in evaluating the need for treatment.

M	ISSUE / CONCERN	RESPONSE
d.	Can you provide a qualitative description of the contents of the landfill gases?	Vent sampling in both July and October 1984 provided a qualitative assessment of the constituents of the landfill gases. The more prevalent gases found in the vents have been noted below in declining order of magnitude: • Vinyl chloride • Chloroethane • Methylene chloride • Acetone • Carbon disulfide • 1,1-Dichloroethane • Trans-1,1-dichloroethane • 2-Butanone (MEK) • 1,1,1-Trichloroethane • Benzene • 4-Methyl-2-pentanone (MIBK) • Tetrachloroethene • Toluene • Chlorobenzene • Ethyl benzene • Xylenes • 1,2-Dichloropropene • Trichloroethene • Chloromethane • 1,1-Dichloroethene • 1,2-Dichloroethane

EM O.	ISSUE / CONCERN	RESPONSE
.e.	What causes the odor in the gases? It is especially noticeable when driving along Route 3.	The odor in the gas emitted from the landfill is produced by the presence of compounds which have arisen from the breakdown of organic refuse in the absence of oxygen. Such compounds include sulfides and mercaptans. As an example, hydrogen sulfide is typically referred to as "rotten egg gas". Mercaptans are a class of organic compounds which possess a sulfhydryl group and may readily form sulfides or disulfides. Carbon disulfide was found in numerous samples from the site, while methyl disulfide was found in vent samples. The Charles George landfill is not unique in producing these types of gases; they are typical of off-gases from any landfill which has accepted sanitary wastes.

M O.	ISSUE / CONCERN	RESPONSE
.f.	Can you explain the venting and treatment process? Would the treatment eliminate the noxious odors?	As shown in Figures 2-5 through 2-7 in the draft Source-Oriented FS Report, a typical vent installation would consist of a length of 4-in (O.D.), perforated plastic pipe. This pipe would extend from a zone of gas generation deep within the landfill to a crushed stone gas collection layer which will be placed on the present landfill surface. Oxygen from the air is unable to penetrate very deeply into the landfill and will penetrate even less after the landfill is capped. As organic materials break down within the landfill in the absence of oxygen, compounds such as mercaptans and sulfide and methane gas are generated. The landfill vents will tap these zones of gas production and provide a route for controlled gas migration to the surface. Gases from zones not directly tapped by the plastic pipe vents will migrate upward and will come into contact with the crushed stone layer immediately underneath the landfill cap. This crushed stone layer will facilitate lateral movement of the gases until they encounter a vent.

M).	ISSUE / CONCERN	RESPONSE
		The gas vent will be an unperforated length of 4-in plastic pipe above the crushed stone gas collection layer. After the gas enters the unperforated portion of the vent it may be either discharded at the open end of the vent, or it may be collected along with gases from other vents for treatment at a common point. Treatment will include the use of activated carbon filters, which will eliminate the noxious ordors in the landfill gases. These odors are caused by mercaptans and sulfide gases. The other volatile organic gases that accompany these malodorous compounds will also be eliminated from the landfill gases by treatment. However, additional studies need to be conducted before it is determined if treatment of the vent gases is necessary. As one of the tasks for the Phase III, EPA is in the process of developing a quantitative air monitoring plan. The results for the study will be included within the Remedial Investigation scheduled to be completed Fall of 1985.

M	ISSUE / CONCERN	RESPONSE
g.	Do gases coming from the landfill vents pose any fire hazard?	Gases emitted from the existing landfill vents, as well as those which may be collected and discharged from the proposed gas venting system, do not pose a fire or explosion hazard. Methane is an explosive gas under certain conditions. However, in order to pose a risk of explosion the methane must be confined so that the gas can concentrate to explosive levels. These conditions do not exist at present because of the ease with which the vent gases can mix with the ambient air. In designing the venting system, adequate precautions will be taken to ensure that the risk of fire or explosion is eliminated.

EM O.	ISSUE / CONCERN	RESPONSE
.h.	An adequate atmospheric study has not been done at the site to fully characterize air flow patterns, including seasonal, diurnal, and recurring weather patterns. The lack of this data renders the air sampling data meaningless.	There has been no effort to date to conduct an atmospheric study at the site which would yield data essential to defining local climatologic conditions. The limited data collected to date include wind speed and direction and air temperature. These data have been collected by a portable meteorological station which has been in place at the landfill since September 1984. A continuous recording rain gauge was placed onsite at the same time. The data obtained from the onsite recording instruments, coupled with historic data from weather stations in the local area (Nashua Airport, Hanscome Field, University of Lowell) will be used to develop a preliminary understanding of local weather patterns.

EM IO.	ISSUE / CONCERN	RESPONSE
1.	The sampling methods used to collect ambient air samples are inappropriate. Rather than adsorbent tubes, the sampling orifice should be large, with air drawn through the collection chamber over a significant period of time and under all prevailing weather conditions and air flow patterns.	Sampling methodology, as well as sample handling and shipment, followed EPA-approved protocols and was fully documented in notes taken in the field at the time of sampling. The use of adsorbent tubes with calibrated pumps operated over the time periods employed in the field study is based on the accepted literature and is an accepted practice in the field. Articles of literature which support these sampling methods include "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air" (EPA Document No. 600/4-84-041, April 1984) and "Organic Solvents in Air" (NIOSH Manual of Analytical Methods, Second edition, Volume 1, Department of Health, Education and Welfare publication No. 77-157-A). The use of high-vol samplers, which draw high volumes of sample per unit time through a large diameter orifice and across a cellulose filter, is restricted to those situations where the contaminants of interest are particulates or chemicals adsorbed to the surface of particulates. This is not the case at the Charles George Site, where the contaminant of concern is volatile organic gases.

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		The limited duration of the field study permitted during the RI/FS and the availability of analytical resources through the EPA Contract Laboratory Program did not allow the collection of air samples during all prevailing weather conditions and air flow patterns. In addition, such characterization was not considered necessary in the context of the preliminary study.

M).	ISSUE / CONCERN	RESPONSE
J.	Does proximity to the site create any hazard to the residents at the present time?	Before the field investigation was started, a health and safety reconnaissance was conducted using an instrument (HNu) sensitive to the presence of volatile organics in the air. The site was also surveyed using a meter capable of identifying the presence of any radiation. Based upon the reconnaissance, the level of personal protection defined for the personnel who performed the site investigation work did not require the use of any respiratory protection, except for activities which involved collecting samples from the leachate sumps on the eastern and western peripheries of the landfill. The latter was required because these sumps are enclosed spaces where gases may accumulate. Analytical data from the site investigation, as well as health and safety surveys of the site area do not indicate that the site presents an imminent threat to residents in the surrounding area. The degree of hazard posed by the site on a chronic basis (years) will be evaluated in the risk assessment completed as a part of the [illegible] Report, which is due in mid-summer.

EM O.	ISSUE / CONCERN	RESPONSE
.a.	ALTERNATE WATER SUPPLY (PERMANENT WATER LINE) If wells are found to be contaminated North of Blodgett Road, will the present water line be extended?	The permanent water line to be constructed from the North Chelmsford Water District in Lowell, Massachusetts, to the Cannongate area has been designed with capacity in excess of that required at the present time. If residential wells along Blodgett Road, or, for that matter, along Dunstable Road northwest of the site, were found to be contaminated as a result of the Charles George Site adequate capacity exists to provide a permanent alternate water supply.

ISSUE / CONCERN	RESPONSE
ENVIRONMENTAL SAMPLING/RESIDENTIAL WELL SAMPLING	
Soil samples were taken south of Blodgett Road. How many were taken north of this roadway?	No soil sampling was done north of Blodgett Road. Soil sampling was confined to the site area itself. No sampling of soils off of the landfill was done during the field study. Sampling of soils was done to determine whether erosion of suface soils from the landfill may provide a route of contamination to receiving streams. Streambed and lake bed sediments were sampled in Dunstable and Bridge Meadow Brooks, and in Flint Pond. The objective was to determine the extent, if any, of contaminant migration from the site as a result of deposition of eroded soil in the stream channels or lake.

ISSUE / CONCERN	RESPONSE
How many residential wells were sampled north of Blodgett Road and in the Flint Pond area? Surface water sampling apparently ignored the northwestern portion of Flint Pond. Residents in Dunstable, northwest of the site, expressed a similar concern regarding the frequency of sampling of their wells.	The NUS Field Investigation Team (FIT) has been conducting a quarterly residential well sampling program in parallel with the Remedial Investigation. Residential wells along Blodgett Road to the north of the site were sampled on two occasions in 1903. In the first of these, one well was tested, while in the second eight were tested. Organic contamination less than 2 parts per billion (ppb) was found in two samples taken during the second sampling round. One well was found to contain chloroform, while the other was found to contain 1,1,1-trichloroethane.
The general inference here is that there has not been enough sampling done in these areas.	During the Remedial Investigation, two wells north of Blodgett Road used for drinking purposes were sampled and two wells not currently used as potable water supplies were also sampled. No contamination was found in these wells. Results of past hydrogeologic studies, and of that recently completed by the REMPO, indicate that groundwater contamination from the site area does not appear to migrate to the northeast. Therefore, there was no basis for extensive sampling in this area.

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	In response to public comments, however, the EPA has developed a supplemental well sampling program which was undertaken in mid-May and included a number of the residences along Blodgett Road as well as along Dunstable Road northwest of the site entrance.

ISSUE / CONCERN	RESPONSE
Is groundwater flowing through fractures in the bedrock? What direction are contaminants being carried by groundwater flowing in the bedrock?	To the north of the landfill very little unconsolidated material exists above bedrock. To the south of the landfill unconsolidated deposits are somewhat deeper, but are still less than 20 feet in depth. While groundwater does exist within the unconsolidated deposits, the greater portion of the aquifer in the site vicinity occupies fractures within the bedrock. Within the fractured bedrock, flow directions are governed by the orientation of the fractures and by the degree to which the fractures are pumped by wells. For instance, groundwater flow from the southeastern periphery of the landfill could have been induced in the direction of the Cannongate wells during their active operation.

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The sampling program implemented at the site is "not in accord with standard professional analytical protocols for site selection for sampling, but displays an irregular and incomplete pattern of sampling with complete disregard for statistical parameters of significance and the basic underlying groundwater hydrogeology."	The location of environmental sampling stations (for surface water, groundwater, soil, sediment, benthic macroinvertebrates, and fish) was based upon a review of the available data regarding the extent of contamination in all media. For example, the sampling locations and frequency of sampling were designed to characterize background and potentially impacted zones in Dunstable and Bridge Meadow Brooks, in order to provide adequate points of comparison to evaluate the extent and potential effect of contaminant entry into receiving streams. The nature of the data base (low number of replicate samples, large number of approximated data) is such that statistical manipulation is not a possibility in most cases. The important point is that a primary objective of the environmental sampling is not to precisely characterize the extent of contamination within the site area, but to define the contamination in a manner which is sufficient to determine the best application of remedial measures. A crucial portion of this objective is definition of the nature and extent of contamination in

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	adequate detail to permit a meaningful evaluation of the present and potential risk to the general population and the environment. In conclusion, the goal of the environmental sampling was not necessarily to produce a data base amenable to statistical tests of significance. Rather, the objective was to identify the general extent of contamination and potential migration pathways.

ISSUE/CONCERN	RESPONSE
REMEDIAL DESIGN	
Does EPA plan to investigate specific areas of contamination within the landfill prior to capping? Drums may be located within the landfill which would pose an ongoing threat of contamination if they start to leak. Will EPA attempt to isolate zones of more intense contamination within the landfill and treat these differently prior to capping?	EPA is aware that both drummed and bulk (i.e., tanker truck deliveries) volatile organics were disposed of in the landfill from 1973 to 1975. Quarterly reports made by Charles George do not specifically identify the areas in which disposal took place. Identification of zones of more intense contamination within the landfill after the fact would have required the use of remote sensing techniques such as magnetometer surveys and other types of geophysical techniques. The depth of cover material over potential areas of volatile organic waste disposal (in some cases as much as 200 feet) and the interferences which might be anticipated from miscellaneous refuse placed in the landfill would pose difficulties in accurately interpreting the results. The only means by which the presence of specific zones of contamination could be verified would be through direct excavation of the landfill. Not only would this pose a health risk to the remedial investigation personnel, and potentially to the surrounding public in the event of an unanticipated release, but also the work would be labor

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	intensive and extremely costly. Excavation into the landfill would also pose the risk of igniting the wastes, resulting in a subsurface fire which would be very difficult to deal with. In the event that concentrated zones of contamination could be identified, the logistics of removing these zones and finding suitable secure disposal areas would be a difficult task, and could potentially present additional health risks for the local population. Notwithstanding the above, the EPA has been conducting an ongoing investigation into potential contributors of hazardous wastes to the landfill. In conjunction with this, information has been sought relative to specific areas of the landfill which were used for waste disposal. The present EPA position is that excavation into the landfill is not justified in light of the inherent risks.

ISSUE / CONCERN	RESPONSE
How will the clay cap keep water from causing further problems?	Clay materials, properly compacted, will provide a zone of low permeability material over the surface of the site. The objective of this zone is to shed rainwater or snow melt which runs onto the landfill so that the water does not penetrate and percolate down through the refuse, bringing potentially hazardous compounds into solution and forming a leachate. Surface water runoff from the capped area will be collected via a system of diversion channels and conveyed off site through sedimentation basins.

ISSUE / CONCERN	RESPONSE
As part of the remedial action, discharge from the culvert from the landfill which carries drainage under Route 3 to Flint Pond Marsh should be addressed. Flint Pond Marsh should be sealed off from Flint Pond proper, and the entire area dredged to prevent contaminants deposited in the marsh from migrating into the pond.	The question of whether Flint Pond Marsh should be sealed off and/or dredged will be addressed in the offsite study of remedial alternatives. Additional sampling of the marsh sediments is proposed as a part of the field investigations for this phase of the work in order to determine whether dredging of the sediments would significantly reduce the contaminant load to Flint Pond.

ISSUE / CONCERN	RESPONSE
Is the landfill presently capped with clay?	The landfill is not covered with clay. It is presently covered with a sandy soil. Those areas which had not been covered by Charles Geoerge were covered by the EPA Emergency Response Team (ERT) during the winter of 1983-1984. While no refuse is exposed on the surface of the landfill at this time, revegetation of the soil cover is not complete. In addition, the sandy soil cover, coupled with the irregularities in the landfill surface, does little to limit infiltration of surface water.

ISSUE / CONCERN	RESPONSE
Will there be any difference in logistics, and particularly in the number of haulage trucks, if a flexible membrane cap is used instead of a clay cap?	Because of the volumes of crushed stone, sand, and borrow soil which will be required irrespective of whether a clay cap or a synthetic membrane cap is installed, the actual difference in number of haulage trucks will be minimal. With respect to the full clay cap, the clay component makes up approximately 196,000 cubic yards (cy) of the total 615,000 cy of material required. The total volume of material (crushed stone, sand buffer, borrow soil, topsoil) required in connection with the full synthetic membrane cap has been estimated at 419,000 cy. At approximately 17.5 cy per haulage truck, this still would translate to approximately 24,000 trucks.

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What is the availability of a flexible membrane?	Flexible membranes are produced by a number of fabricating firms. While the availability may not be immediate, enough lead time will be available for its procurement while the site is being prepared so that availability will not be a critical factor in the project schedule.

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How many truckloads would be required in order to remove the entire landfill?	Removal of the entire landfill mass is not a realistic possibility. Assuming the capacity of a haulage truck to be 20 cubic yards (cy) in order to adhere to Massachusetts weight restrictions for haulage on state roads, it would require an estimated 226,000 trucks to entirely remove the 3,950,000 cubic yards of material. To carry this a little further, with six trucks operating at four round trips per day, the estimated time for removal of all of the landfill would be about 40 years.

RESPONSIVENESS SUMMARY CONTINUATION

CHARLES GEORGE SITE
TYNGSBOROUGH, MASSACHUSETTS
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1	ISSUE / CONCERN	RESPONSE
	What is contained in the industrial waste dumpsters? What will be done with the dumpsters?	The majority of industrial waste dumpsters are empty. It appears that they were being stockpiled onsite pending the need for their use. However, those which are not empty contain industrial refuse. Screening of each dumpster with an HNu during initial reconnaissance identified no volatile organic contamination. In their present location, the dumpsters are an obstruction to regrading, and will require relocation onsite at the very least in order to permit effective site closure. The ultimate fate of the dumpsters has not yet been determined. The possibility exists, however, for them to be decontaminated and disposed offsite. It is also possible that they may have some salvage value.

ISSUE / CONCERN	RESPONSE
Will a synthetic liner (flexible membrane) break down when it comes into contact with other chemicals or contaminants? How long will the membrane last?	The synthetic liner application at the Charles George Site is somewhat different than the manner in which the liner might be used in the preparation of a new refuse disposal site. In development of a new site, the liner would be placed at the bottom of the site to contain the wastes. Following completion of each waste cell a liner would be placed over the wastes and mated with the bottom liner to form a complete capsule for the wastes. In this type of application the liner material is in intimate contact with the waste materials and must be designed to be compatible with the wastes. As a cover for the Charles George Site the primary objective is to provide a low-permeability cap for the landfill to reduce infiltration of surface water. As such, the membrane will not be in direct contact with the leachate, and compatibility between the leachate and the liner material will be less critical. The liner will also be protected from mechanical damage by virtue of the manner in which it will be constructed (i.e., sandwiched between two six-inch layers of sand), and will not be exposed to wind and weather.

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	Liners made of polyvinyl chloride (PVC), for example, are sensitive to ultraviolet light and require at least 12 inches of soil cover to provide adequate protection from sunlight. The estimated lifespan of liner materials actually exceeds the period of time for which historical data exist. Use of membranes is relatively new in site closure. The first extensive use did not occur until the 1970's. Based upon accelerated laboratory testing (with elevated temperatures, rapid temperature fluctuations, extreme loading, etc.), it appears that life expectancy at optimum performance will be about 20 years. Some estimates are as high as 30 years. As with a clay cap, periodic maintenance will be required to prolong the life of the membrane cap.

ISSUE / CONCERN	RESPONSE
What design criteria will be employed in developing the remedial design following the selection of the remedy?	EPA will select an alternative for remedial action. CDM will then develop criteria for the preliminary design.

ISSUE / CONCERN	RESPONSE
What criteria will be used in making the decision between a clay cap and a synthetic membrane?	The technical criteria to be used in deciding between a clay cap and synthetic membrane, as outlined in the Source-Oriented FS Report, are as follows: • Substrate grade requirements • Permeability requirements • Material availability • Resistance to degradation • Reduction of leachate generation Since the degree of benefit is essentially equivalent with each type of cap material, cost and institutional requirements (public opinion, regulatory requirements) will also be important factors to be addressed in making the decision. In addition to evaluating the alternatives proposed for this site, the cost of remedial action at the Charles George Site will be balanced with the costs of proposed remedial actions at other sites. Based on this comparison, the EPA Regional Administrator will define the best allocation of monies from the "Superfund".

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ISSUE / CONCERN	RESPONSE
Dunstable Road is a light-duty roadway. We do not want large dump trucks and heavy equipment travelling over the roadway in large numbers. What will be done to avoid this during the clean-up process?	The EPA is currently examining alternatives to the use of Dunstable and/or Blodgett Roads as haulage routes. All other alternatives will be exhausted before any decision is made to use these roadways.

ISSUE / CONCERN	RESPONSE
How long will the capping process take to complete?	The duration of the capping process will depend upon weather conditions, and also upon whether clay or synthetic membrane capping materials will be used. It is conceivable that construction will have to avoid poor weather conditions during the winter months. It is EPA's intent to obligate construction monies by September, with construction to be initiated during the fall of 1985. It is possible, however, that a decision may be made to defer the start of the work until spring 1986 in order to take advantage of better weather conditions.

ISSUE / CONCERN	RESPONSE
What will be done with the leachate that is generated while the cap is being installed? Will leachate flow continue from the landfill during the capping?	Four potential alternatives are being considered to address the problem of leachate handling during the interim period while the cap is being constructed. These will be presented as an addendum to the Source-Oriented Feasibility. The four alternatives are listed below: ● Treat leachate collected in the sumps on either end of the site, and discharge the treated leachate to Dunstable Brook and Flint Pond Marsh ● Pump leachate from the sumps into tanker trucks as required and haul the leachate to a publicly-owned treatment works (POTW) for treatment ● Recirculate the leachate from the sumps to the top of the landfill on the east and west, thus eliminating any discharge to surface waters ● No Action (i.e., permit leachate to discharge to Flint Pond Marsh and Dunstable Brook as it does presently)

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	While the No Action alternative has been eliminated, a firm decision by the EPA and DEQE has not yet been made regarding the remaining alternatives. It is important to note that the above alternatives are interim measures to minimize further leachate contamination of the area surrounding the landfill. These measures will be implemented in conjunction with capping to reduce infiltration of surface water into the landfill. Even after capping some leachate will continue to be produced within the landfill. This is so for the following reasons: • difficulties in achieving 100% elimination of infiltration of surface water into the landfill, irrespective of the type and configuration of cap • residual moisture in the soil and refuse material within the landfill, which will be forced out with decomposition and settling of the landfill

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	• the probability that the base of the landfill is in contact with the local groundwater system A long-term response will therefore be required to address leachate generation by the landfill. Alternatives to achieve this objective will be addressed in the Phase III Feasibility Study, which will focus upon off-site control measures.

ISSUE / CONCERN	RESPONSE
How will you isolate the site to prevent erosion and sedimentation in receiving streams once you start to do the earthwork on the site?	The means by which further leachate discharge to Dunstable Brook and Flint Pond Marsh will be mitigated during the construction phase will be addressed in the Final Feasibility Study Report. This design will also address means by which erosion and sedimentation control will be provided in order to avoid degradation of the receiving streams. Approval of an Erosion and Sedimentation Control Plan will be required by the state of Massachusetts prior to initiation of construction activity. This plan will be available for public review as well. In addition, a Site Safety Plan will be developed to address appropriate actions in the event of an unanticipated release of contaminants from the site during the construction phase. This plan will also be available for public review prior to the start of construction.

	ISSUE / CONCERN	RESPONSE
1	What are the possibilities of using "innovative" techniques such as placing a "bowl" under the landfill to prevent migration of contamination into the groundwater system?	Innovative technologies, such as in-situ destruction or encapsulation (or building a "bowl") of the wastes, are applicable primarily to sites where the waste materials are readily accessed, and where the quantities of wastes are not large. Neither of these conditions are met at the Charles George Site. The logistics of total encapsulation of the 3,950,000 cubic yards of material estimated to comprise the volume of the landfill are beyond the limits of technical feasibility. If not eliminated on the basis of cost, the potential for uncontrolled release of contaminants to the environment would be similar to that for total removal of the landfill contents.

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LEGAL/ADMINISTRATIVE ISSUES Will the public have an opportunity to appeal the decision made by EPA regarding the selected remedial alternative?	The public has the opportunity to comment without specific right to appeal the decision. EPA will select the most cost-effective remedy. If the public desires a less cost-effective remedy, the opportunity exists to suggest that the Massachusetts Department of Environmenetal Quality Engineering (DEQE) pursue this alternative with the EPA.

M).	ISSUE / CONCERN	RESPONSE
).	An alternate water supply should be provided for residents along Flint Pond.	If residential wells along Flint Pond are found to be adversely affected by contamination migrating from the Charles George Site to the point that the public health could be threatened, an alternate water supply would be a potential remedy. Any action to be taken in this area would be subject to additional study prior to implementation. This alternate supply may or may not be the same as that which is presently being brought into the Cannongate area from the North Chelmsford Water Authority in Lowell.

EM O.	ISSUE / CONCERN	RESPONSE
.c.	With respect to funding, does EPA have to request all of the money from the Superfund at one time, or can you go back for additional funding as needed? In particular, will funding of Phase II now jeopardize Phase III (off-site) funding later?	The funding of Phase I, the Permanent Alternate Water Supply, and Phase II, Source Control, have no bearing on potential funding for Phase III, offsite control. It is convenient for the EPA to expedite action at Superfund Sites by subdividing the remedial actions, instead of waiting until the site has been completely studied, and all of the classes of action have been evaluated.

ISSUE / CONCERN	RESPONSE
What is the schedule for Phase III?	The Remedial Investigation Report is scheduled to be available in mid-summer. The Feasibility Study of Off-Site Control Measures will be completed in early fall and another round of public meetings and hearings will occur at that time to discuss the recommendations made in that report.

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How do you take public comments into consideration in making a decision?	EPA will carefully consider public comments received informally at the informational meeting (held on March 28), and comments received formally at the public hearing (held on April 16), in reaching a decision regarding the most suitable remedial action at this site. In addition, EPA will carefully consider comments obtained from written letters of correspondence. Local concerns are a factor in selecting a remedial action, in addition to technical feasibility, protection of public health and the environment, and cost. All public comments are recorded and responses are provided in this Responsiveness Summary. Copies of this report will be made available (at the Tyngsborough Town Hall) so that citizens can see how each comment was treated.

ISSUE / CONCERN	RESPONSE
When will EPA complete the remedial design and obligate funds for construction?	The remedial design will be initiated by Camp, Dresser, & McKee (CDM), under contract to the EPA, as soon as the recommended alternative has been defined by EPA. This is formalized in a Record of Decison (ROD) document. Signing of the ROD is anticpated during June. CDM will initiate design immediately after ROD approval by headquarters EPA. EPA hopes to have a completed design by August or September, ready to initiate the process of soliciting bids for construction. Obligation of funds for construction is anticipated by September 1985.

ISSUE / CONCERN	RESPONSE
Flint Pond Marsh should be included in the definition of "on-site".	Since the site usually is conceived of as a source of contamination, the landfill itself and private access roads to the landfill constitutes the site in this instance. The Flint Pond Marsh area is actually a receptor of contamination. Remedial measures required to deal with this area will be evaluated in the context of the Phase III study of off-site control. The fact that Flint Pond Marsh has not been included in the definition of the site does nothing to reduce the importance of its address in the Phase III study as both a receptor of contamination and a potential source of additional contamination to Flint Pond.

M .	ISSUE / CONCERN	RESPONSE
1.	What is the interrelationship between Phase II and Phase III (Off-site Feasibility Stydy)? Is it possible that the results of the off-site study may nullify all or a part of the work done in support of Phase II source control?	EPA is not of the opinion that the results of the Phase III study will in any way negate the work done under Phase II. Establishment of a cap on the landfill will minimize the threat of surface and groundwater contamination from the site. However, it will not eliminate it entirely, and that is where Phase III is tied into the overall program for remedial action at this site.

RESPONSIVENESS SUMMARY CONTINUATION

CHARLES GEORGE SITE
TYNGSBOROUGH, MASSACHUSETTS
JUNE 1985

ISSUE / CONCERN	RESPONSE
Who owns the site now? Who will own the site after it is cleaned up?	The current owners of the site are Dorothy George as an individual and James George as trustee of Charles George Land Redclamation Trust. After clean-up their ownership will continue.

ISSUE / CONCERN	RESPONSE
Is money an issue in deciding which alternative will be selected for cleaning up the site?	As noted on page 31 of this summary, in addition to evaluating the alternatives proposed for this site, the cost of remedial action at the Charles George Site will be balanced with the costs of proposed remedial actions at other sites. Based on this comparison, the EPA Regional Administrator will define the best allocation of monies from the "Superfund".

M).	ISSUE / CONCERN	RESPONSE
k.	What is the state ranking of the site? Does the ranking of the site take into consideration the degree of hazard posed by each individual site, or does it rank the hazard with respect to all sites listed?	The State recommends those sites to be ranked. The ranking of the sites is consistent with criteria established by the National Contingency Plan (NCP). The ranking is based upon an evaluation of factors such as, specific quantities and types of wastes, observed releases, and proximity of receptors. The Charles George site was ranked 163rd of 418 sites on the December 1982 National Priorities List (NPL). The position on the list is not necessarily indicative of the degree of hazard, but does indicate the potential for impact to the surrounding environment and the threat posed to public health and welfare.

M).	ISSUE / CONCERN	RESPONSE
a.	EXTENT OF CONTAMINATION What are the difficulties in addressing groundwater contamination from the site?	Studies to date have indicated that the potential exists for contamination from the site, i.e., leachate, to have entered the groundwater system and moved vertically through fractures in the bedrock to relatively significant depths. The lack of a sigificant quantity of unconsolidated material above bedrock indicates that most of the aquifer of concern lies within bedrock. It has been alleged that the wastes within the landfill may have been placed directly on bedrock, with no intervening material. If contamination has entered bedrock it may be migrating from the site in the bedrock fractures, i.e., turbulent flow. Under conditions where the bedrock is not fractured, or where contamination is found in the unconsolidated deposits, flow takes the form of an advancing contaminant front (laminar flow). This flow system can be modeled, and the extent of contamination can be predicted based upon assumptions regarding the rate of advance of the contaminant front. Based upon a projection of the migration of contaminants, monitoring wells can be installed to verify the presence or absence of contamination and

M	ISSUE / CONCERN	RESPONSE
		data from these wells can be added to the model to extrapolate additional projections of extent of contamination. Contaminant movement, and groundwater flow within fractured bedrock is less amenable to modeling and prediction, since the medium through which the groundwater is moving is not homogeneous. There is no advancing "contaminant front", but rather the contamination is carried by the fractures to varying distances from the source dependent upon the degree of fracturing, its orientation, and differentials in piezometric heads which drive the groundwater through the fractures. Not only is it difficult to define the extent of contamination in fractured bedrock, butalso it is difficult to define remedial measures which are successful in intercepting the contamination and evacuating it from the groundwater system. Similar difficulties would be encountered in defining means by which barriers to groundwater flow could be constructed.

ISSUE / CONCERN	RESPONSE
	In unconsolidated material underlain by relatively impervious bedrock, it is possible to install barriers to lateral groundwater movement. However, if the bedrock is fractured, the effectiveness of a barrier within the unconsolidated deposits is drastically reduced, since the groundwater has a potential route around the barrier via the fractures.

ISSUE / CONCERN	RESPONSE
TECHNICAL COMMENTS The Source-Oriented Feasiblity Study Report should provide a more detailed discussion of the results of the hydrogeologic investigation done during the Remedial Investigation. It should take into consideration past studies done by CDM and others.	The results of the hydrogeologic investigation done in concert with the RI/FS will be fully evaluated in the Remedial Investigation Report, which will be available by late summer. An understanding of the hydrogeology of the site is important to the definition of remedial action. However, the primary goal of the Source-Oriented Feasibility Study was directed at evaluating techniques which may be valuable in mitigating the source of contamination. A detailed description of site hydrogeology was not presented in this report, since this issue is more pertinent to evaluating means of mitigating off-site migration of contamination.

ISSUE / CONCERN	RESPONSE
The feasiblity of action to remediate the present groundwater contamination was not discussed in the Source-Oriented FS Report.	Actions required to address groundwater contamination which has occurred, or which may occur as a result of off-site migration of contaminants from the landfill, will be addressed in the context of the Phase III study.

ISSUE / CONCERN	RESPONSE
The Source-Oriented FS Report indicates that inorganic contamination "does not appear to be a severe problem." How can this be the case when arsenic levels are shown which are significantly in excess of the EPA Primary Drinking Water Standard?	As a group, inorganic contaminants do not represent as significant a threat as do the organics. This is because inorganic contaminants, including arsenic, are not as wide spread and have not been found in as high levels in bedrock-groundwater as the organics have. Nor have inorganic contaminants been found in domestic supplies and Cannongate wells as have organic contaminants. Arsenic has been found, albeit in lower concentrations than in previous studies (800 vs 23,000 ppb) in shallow groundwater and site leachate near the Route 3 drainage area and in shallow wells adjacent to the southwestern periphery of the landfill. The potential risks to public health and environment posed by these situations will be fully addressed in the Risk Assessment included in the RI Report which will follow the Source-Oriented Feasibility Study.

ITEM NO.	ISSUE/CONCERN	RESPONSE
7.d.	In terms of possible receptors, why was the Merrimack River not mentioned, as it serves as a source of drinking water for the cities of Lowell, Methuen, and Lawrence, downstream of the site.	The Merrimack River was not noted as a potential receptor of contamination from the site, since the migration pathway from the Charles George Site to the Merrimack is via Flint Pond. The field sampling did not document contamination via surface water flow through Flint Pond, and the potential for the Merrimack to act as a discharge area for groundwater flowing through bedrock fractures is undetermined. In any event, sampling of the Merrimack, which would have been done had it been considered a logical point of impact for contamination from the site, would in all likelihood have been inconclusive. In other words, because of the potential for the Merrimack River to receive contamination from a variety of sources other than the Charles George Site, the finding of contaminants in samples from the Merrimack River would not have been a conclusive indictment of the Charles George Site as the source.

ATTACHMENT 4

EXECUTIVE SUMMARY
COMMUNITY RELATIONS RESPONSIVENESS SUMMARY
CHARLES GEORGE LANDFILL
TYNGSBOROUGH, MASSACHUSETTS

This report summarizes major issues and concerns raised during the public comment period (March 29 to April 19, 1985) for the draft Source-Oriented Feasibility Study (SOFS) for the Charles George Landfill Site.

Citizens directed numerous comments to the EPA as well as to town selectmen concerning air quality and potential adverse health effects from landfill gas emissions. The noxious odor was frequently cited as a basis for this concern.

EPA explained that a detailed atmospheric study has not been done at the site to date but that additional studies may be conducted in the future. During the Remedial Investigation (RI) field study, samples were taken from the gas vents to identify gas composition. Specific gases identified are listed in the SOFS report. EPA may plan for additional air monitoring in the future to better define potential impacts on air quality. In conjunction with capping the site, EPA intends to install a gas venting system to collect landfill gases before releasing them directly into the air. The Remedial Action Design Report, to be submitted this summer by Camp, Dresser, and McKee, will further address air quality and gas vent construction/design.

Citizens also expressed a great deal of concern about the environmental sampling and well-sampling programs. Specifically, comments addressed lack of soil sampling north of Blodgett Road. Additional comments focused on the lack of residential well sampling in three areas: north of Blodgett Road, in the Flint Pond area, and northwest of the site in the Dunstable area. Because groundwater is thought to be flowing through fractures in the bedrock, it is difficult to determine the direction of groundwater flow. Citizens have expressed concern over this uncertainty and over the selection of sampling points around the site.

The EPA explained that no soil samples were taken north of Blodgett Road because soil sampling was confined to the site area. Streambed and lakebed sediments were sampled in Dunstable and Bridge Meadow Brooks, as well as in Flint Pond, to determine the extent, if any, of contaminant migration from the site. A residential well sampling program has been conducted on a quarterly basis in conjunction with the RI. Residential wells north of Blodgett Road were sampled on two occasions in 1983. On the first occasion, one well was tested; on the second, eight wells were tested. Results of these tests will be included in the RI report. EPA stated, however, that in response to public comments, a supplemental well sampling program has been developed and will include a number of the residents along Blodgett Road, as well as along Dunstable Road northwest of the site entrance, and in the Flint Pond area. This sampling occurred during the week of May 13, 1985.

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EPA explained that the selection process for the sampling locations was designed to yield the most information so as to best define the nature and extent of contamination.

Residents in the Cannongate and Dunstable areas questioned the remedial design concepts, particularly as they relate to eliminating or controlling leachate contamination to Flint Pond and nearby brooks in that area. Concerns revolved around capping options: Will EPA attempt to isolate zones of more intense contamination within the landfill and treat these areas differently prior to capping? Will the Flint Pond Marsh be sealed off and/or dredged? Which capping material is most effective, least costly, and most easily obtained? What criteria will be used in selecting a capping material? What are the logistics of transporting the large quantities of soil and other construction materials to the site area? In particular, the citizens were concerned about the use of Dunstable Road by haulage trucks and construction vehicles during the cleanup procedure.

EPA explained that the only means by which the presence of a specific zone of contamination could be verified would be through direct excavation of the landfill. Because of the health risks involved and the intensive labor costs, this option was not considered. Other remedial actions for the site, particularly technical aspects of capping options, will be addressed more fully in the RI report. Additional sampling of the marsh sediments was conducted during the period from May 13-16, to determine whether dredging of the marsh would reduce contamination of Flint Pond. With regard to the logistics for the haulage of materials, EPA explained that alternative routes of transportation would be investigated.

The issue of alternative water supplies for residents along Flint Road and north of Blodgett Road was also raised. If residential wells were found to be contaminated, alternative water supplies would be a potential remedy. However, further study would be necessary to evaluate the feasibility of other alternatives to address the problem.

Citizens expressed concern over the leachate problem in terms of collection, treatment, and storage. Also, they felt that Flint Pond Marsh should be included in the definition of "on site".

EPA responded by describing the four alternatives for leachate collection, treatment, and storage; these alternatives will be outlined in the final SOFS report. Also, EPA explained that Flint Pond Marsh may be a receptor of contamination. Remediation of the marsh will be addressed in Phase III of the study, dealing with offsite contamination.

Concern was expressed about the site's ranking on the National Priorities List. Also, the decision-making process and sources of funding for remedial measures were questioned, as well as whether citizens could appeal the final alternative selection. Additional questions concerned legal aspects of the site, such as present ownership and future responsibility.

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EPA explained that the Charles George Landfill was ranked 163rd out of 418 sites listed on the National Priorities List in December 1982. Sites are ranked according to the risks from potential or actual migration of contaminated substances through groundwater, surface water and air. The Regional Administrator of the EPA establishes the priority for remedial action funding. The site that can get the maximum amount of remediation from the available money is the one that receives the funding. The public has the opportunity to comment without specific rights to appeal. EPA will select the most cost-effective remedy. Should the public desire a different alternative, the opportunity to suggest that the Massachusetts Department of Environmental Quality Engineering (DEQE) pursue that remedy with EPA is available to them.

ATTACHMENT 5

COMMUNITY RELATIONS RESPONSIVENESS SUMMARY
CHARLES GEORGE LANDFILL SITE
TYNGSBOROUGH, MASSACHUSETTS
JUNE, 1985

Introduction

This responsiveness summary documents for the public record concerns and issues raised during remedial planning (prior to the comment period on the Feasibility Study), comments raised during the comment period on the Feasibility Study, and how the U.S. Environmental Protection Agency (EPA) responded to these concerns.

Because of the complex nature of the Charles George Landfill Site, the investigative study was divided into three different phases, briefly outlined below.

Phase I:	Selection and implementation of alternative water supplies for residents in the Cannongate area. A Focused Feasibility Study was conducted to evaluate possible sources of alternative permanent water supplies.
Phase II:	Evaluation and selection of remedial alternatives to control the source of contamination. A Source-Oriented Feasibility Study was conducted to identify the source of contamination and examine possible remedial action.
Phase III:	Investigation to determine the nature and extent of offsite contamination and evaluation and selection of remedial alternatives to clean up the areas. A Remedial Investigation/Feasibility Study is currently in progress.

Phase I construction activities are currently in progress for the chosen alternative. A summary of public concerns and EPA's response was included in the Record of Decision for Phase I. Phase II study has been completed; design and construction activities will begin after a Record of Decision is signed. The Phase III Remedial Investigation is expected to be completed by the end of summer, 1985, and the corresponding Feasibility Study by late fall, 1985.

This Responsiveness Summary focuses on concerns and issues related to Phase II.

Activities Conducted Prior the the Source-Oriented Feasibility Study Comment Period

Periodic fact sheets/progress reports were distributed to residents and officials on EPA's mailing list in order to inform citizens of current activities at the site. Informal meetings were held with key local citizens to brief them on study progress.

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Concerns and Issues Raised Prior to the Source-Oriented Feasibility Study Comment Period

Residents in the Cannongate area expressed considerable concern during this period over possible health effects from contamination spreading from the site. Specifically, the risk of potential well contamination and respiratory effects from airborne contamination caused the greatest concern. Gas emissions, odor, and the potential contamination of Flint Pond and the subsequent loss of the pond as a recreational resource were also cited by citizens in that area.

Although exposed refuse had been covered as a result of earlier actions by EPA, the risk of fire or explosion was still a concern of the community during this time. Concern was also conveyed about the effectiveness of the leachate system and the possible effects of erosion at the landfill.

Citizens expressed an additional concern that the EPA would not fulfill obligations for remedial actions and would end its involvement with the site once the permanent water line was constructed.

Agency/State Response to Concerns and Issues Raised Prior to the Source-Oriented Feasibility Study

As a result of concerns expressed by citizens in the Cannongate area, and in an effort to speed up the overall cleanup process, EPA decided to split the RI/FS into two phases and commissioned a contractor to prepare a Source Oriented Feasibility Study. The objective of this study was to identify the source of contamination at the landfill and recommend remedial actions to control contaminant migration.

Activities Conducted During the Source-Oriented Feasibility Study Comment Period

The final Source Control Feasibility Study was released to the public the week of March 18, 1985. Copies of the report were placed at the Tyngsborough Town Hall and at the Littlefield Library.

EPA held a public informational meeting on March 28, 1985, at the Tyngsborough Junior/Senior High School in Tyngsborough at 7:30 p.m. to explain the findings of the Source Oriented Feasibility Study and to solicit input from the citizens.

Approximately 30 citizens attended the meeting and asked a series of questions pertaining to the proposed remedial methods of capping the landfill and controlling the source of contamination.

A six-page fact sheet summary of the study was prepared and distributed at the meeting by EPA.

A public hearing was held April 16, 1985, at the Tynsborough Junior/Senior High School in Tyngsborough at 7:15 p.m. to receive oral comments from the community.

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Concerns Raised During the Source-Oriented Feasibility Study Comment Period

A high level of concern was expressed by citizens concerning the air quality in the affected area. The selectmen and the Director of Public Health of Tyngsborough directed questions and comments to EPA and the State regarding this matter, and citizens questioned whether a health study would be conducted to determine potential health effects from breathing the air.

Well sampling and environmental sampling programs also were a cause of great concern for residents in the affected area. The perceived lack of adequate sampling was the specific issue addressed.

Additional concern was voiced regarding the leachate collection system, alternate water supplies, and various legal and administrative topics.

Letters addressing these concerns were received by the EPA from Paul G. Dinneen (chairman), Dana E. Metzler, and David E. Tulley of the Dunstable Board of Health and from the following citizens of Tyngsborough: Artie Jackson, Linda Jackson, Gilbert Ohnesorge, and Neil and Kathleen Robinson. A letter from Elizabeth Coughlin of Flint Analytical Service was also received. In addition, comments were submitted at the public hearing by Thomas Borril, Director of Public Health for the Town of Tyngsborough; and seven citizens living in the affected area.

Part II of this Responsiveness Summary addresses more completely these concerns and issues.

Remaining Concerns

PHASE III

A large number of comments received verbally at the meeting and hearing pertained to activities that would occur or are now being addressed under Phase III of the investigative study of the Charles George Landfill. Phase III deals with offsite contamination.

Upon completion and release of the Remedial Investigation report, a public informational meeting will be held to explain the findings of the report and to solicit public input. When the Feasibility Study for offsite contamination is released, EPA will conduct a public comment period on the clean up options.

In response to the comments received concerning air quality and possible respiratory health effects, EPA offered to conduct a small group meeting between members of EPA's Air Quality Division and citizens to discuss the findings of various studies previously conducted.

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ATTACHMENT 6

S. Russell Sylva
Commissioner

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Quality Engineering
Division of Solid and Hazardous Waste
One Winter Street, Boston, Mass. 02108

May 17, 1985

Merrill S. Hohman, Director
Waste Management Division
U.S. Environment Protection Agency
John F. Kennedy Federal Building
Boston, MA 02203

Dear Mr. Hohman:

The Department of Environmental Quality Engineering has received the March 1985, Source-Oriented Feasibility Study for the Charles George Landfill Federal Superfund site in Tyngsboro, Massachusetts. The study, prepared for the Environmental Protection Agency by NUS, presented eight remedial alternatives that were developed to reduce the impact of the landfill on the surrounding aquifer and surface water system. The Department has reviewed the document and is giving the following evaluation on the eight alternatives presented in the study. The recommendations made by the Department in this letter should be included in the Record of Decision (ROD) for the source control phase of the Superfund project.

For discussion purposes, the eight alternatives have been divided into three general categories: (a) Alternatives I through III include those measures that call for the placement of a partial cap to cover designated areas of the landfill, (b) Alternatives IV through VI include those measures that call for the placement of a full cap to cover the landfill, (c) Alternatives VII and VIII include the two conceptual extremes of the eight proposed alternative remedial measures, i.e., complete removal and no action.

The partial cap options, alternatives I through III, present capping configurations that will cover a portion of the landfill. These options call for capping the landfill to the 225 foot Mean Sea Level elevation and include the appropriate technologies to control surface water runoff, leachate generation, erosion, and gas emission for only the capped portion of the landfill. Since a portion of the landfill will remain uncovered and subject to rainfall infiltration, the Department finds that the partial cap options are not in compliance with RCRA landfill closure standards set forth by the Department's Hazardous Waste Regulations, 310 CMR 30.000. Under 310 CMR 30.633(1), (a), the final closure plan for the landfill must provide a design that will minimize the migration of liquids through the landfill. The proposed partial cap options will not meet these requirements.

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what the final remedy will be, at a minimum, it would be useful to discuss the possible "final remedies" such as groundwater interception and treatment, and to further discuss how the cap is consistent with these possible final remedies and how the cap is in fact the only logical source control measure. Appropriate places for such discussion would be on pages 24 and 30 as indicated in the marginal comments. (See also Lynn Peterson's July 3 comment #9).

3. Need for Action Now:

In light of the fact that we are moving forward with a source control measure before all relevant remedial investigation is completed, it is important that the ROD explain why it is necessary to act now as opposed to six months or a year from now to prevent or minimize the release of hazardous substances from the landfill. This discussion could be included at page 11 of the draft ROD.

4. Wetlands:

We recommend that although the ROD may indicate that some alteration of wetlands is unavoidable in providing the cap, it should also indicate that and explain why there is no practicable alternative to the cap in accordance with Section 2 of E. O. 11990. We also recommend that wetlands impacts be included in the discussions of alternatives in the "Alternatives Evaluation" section. (See Lynn Peterson's July 3 Comment #7).

5. Unvalidated Data:

See Lynn Peterson's July 3 Comment #3. We need to develop a position on this problem.

6. Form:

Because the ROD is a lengthy document we recommend that a Table of Contents and numbered sections be added to help orient the reader to the material.

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The complete removal and no action options represent the two remedial measure extremes for the project. The complete removal option calls for the excavation and disposal of approximately 4 million cubic yards of landfill waste in addition to an undetermined amount of contaminated soil. The no action option would only include periodic monitoring of groundwater quality. The Department finds that both these options are unacceptable and basis its determination on the high cost and unknown environmental impacts of the complete removal option and the failure of the no action alternative to mitigate the landfill's impact on various environmental media.

The full cap options, alternatives IV through VI, present capping configurations that will cover the entire landfill area and, similar to the partial cap category, include technologies that are designed to control surface water runoff, leachate generated by rain-water infiltration, erosion of the cover, and gas emissions. Each configuration varies in its selection of a primary capping material. Soil, clay, or a synthetic membrane are presented in the report as alternatives for use as this material. Of the three alternative capping materials, only the selection of a clay or a synthetic membrane could effectively reduce the amount of rain-water infiltrating into the landfill. The use of clay or a synthetic membrane as the primary capping material will function as a relativey impermeable barrier. A full cap option with either clay (Alternatives V) or synthetic membrane (Alternative VI) will significantly reduce the volume of leachate generated in and migrating from the landfill.

It is for this reason the Department recommends the concept of a full cap to be placed over the landfill with either a clay or a synthetic membrane as the primary capping material. The Department understands that the ultimate selection of the primary capping material will be based on an availability of the material and that the design details for the overall remedial action will occur once the concept for the source-control measure for the landfill has been selected.

We look forward to working with EPA to implement a source control remedial action at this site. Should you have any questions in regard to this letter, please contact Bob Bois at 292-5833.

Very truly yours,

Steven A. DeGabriele

William F. Cass
acting Director

WFC/BB/jp

cc: Ed Benoit, DREE, DEQE,CRO
Town of Tyngsboro
Madeleine Kolb, DSHW
Linda Holden-Johnson, EPA
Rick Leighton, EPA